AD-A170 793 AIRCRAFT AVIONICS SUITABLE FOR ADVANCED APPROACH APPLICATIONS VOLUME I AI..(U) RJO ENTERPRISES LANHAM MD S KOWALSKI ET AL. JUL 86 DOT/FAA/PM-86-25/1 1/2

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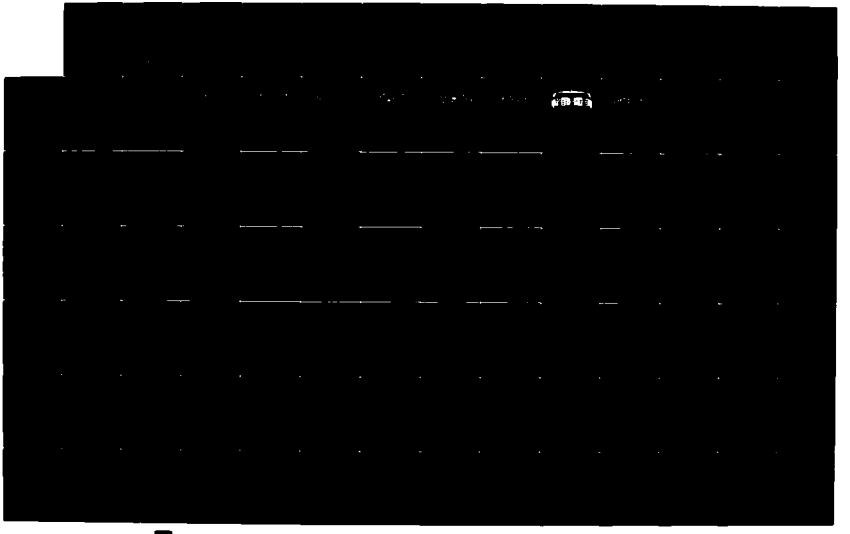

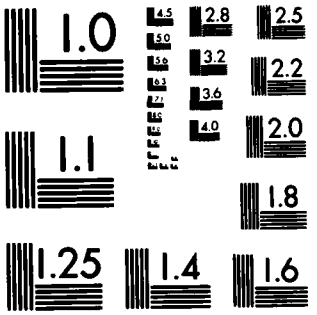

DOT/FAA/PM-86/25,I

Program Engineering
and Maintenance Service
Washington, D.C. 20591

Aircraft Avionics Suitable for Advanced Approach Applications

Volume I, Aircraft Fleet Equipage

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July 1986

U.S. Department of Transportation
Federal Aviation Administration

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ADA170 793

Technical Report Documentation Page

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
DOT/FAA/PM-86-25,I		

4. Title and Subtitle	5. Report Date
Aircraft Avionics Suitable for Advanced Approach Applications Vol. I - Aircraft Fleet Equipage	July 1986
	6. Performing Organization Code
	8. Performing Organization Report No.
7. Author(s) Stanley Kowalski, Thomas H. Croswell	
9. Performing Organization Name and Address RJO Enterprises, Inc. 4550 Forbes Boulevard Lanham, Maryland 20706	10. Work Unit No. (TRAIS)
	11. Contract or Grant No. DTFA01-84-Y-01051
12. Sponsoring Agency Name and Address Department of Transportation Federal Aviation Administration 800 Independence Avenue, S.W. Washington, D.C. 20591	13. Type of Report and Period Covered Avionics Study
	14. Sponsoring Agency Code APM-430

15. Supplementary Notes

APM-430 Cockpit Technology Program Office
J. P. McVicker

16. Abstract

This report catalogs the aircraft avionics suitable for advanced approach applications. The configuration and model numbers of avionics used in navigation and approaches for landing are provided for 79 different types of aircraft. Aircraft are grouped into five user communities which cover Major Air Carriers, Regional Air Carriers, Executive Jets, General Aviation Aircraft, and IFR Helicopters.

Avionics evaluation includes VOR NAVs, ADFs, DMEs, RNAVs, AFCS, weather radar and the associated display instruments. These navigation systems are the most popular units for navigation and landing in todays aircraft. ILS glideslope receivers, marker beacon systems, navigation management systems, vertical navigation systems, and long range navigation systems are not covered.

17. Key Words			18. Distribution Statement
Aircraft Cockpit-Panel	NAV	RADAR	This document is available to the public through the National Technical Information Service, Springfield, Virginia 22161.
Avionics Equipage	ADF	RNAV	
Navigation Avionics	HSI		
Navigation Instruments	RMI		
IFC	CDI		

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price
Unclassified	Unclassified	110	

Form DOT F 1700.7 (8-72) Reproduction of completed page authorized

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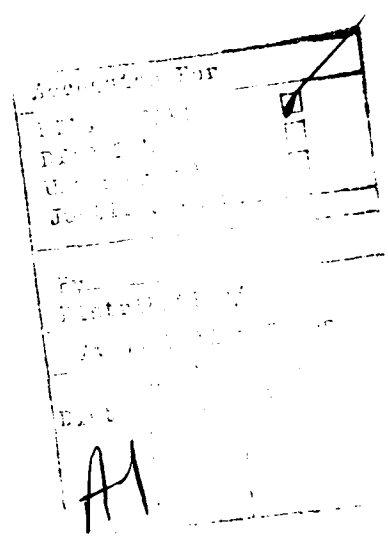


CHAPTER ONE

INTRODUCTION

1.1 BACKGROUND

The National Airspace System is evolving to meet current and future air transportation requirements. System improvements based on new technologies will continue to make the system safe and efficient. The review of current systems aids in the development of compatible and cost effective advanced systems. This study reviews typical avionics configurations for their compatibility in advanced approach applications. Based on this study and other efforts, new concepts will be developed which use existing displays. Simulation experiments will also be developed to analyze systems' capabilities.

The Federal Aviation Administration is in the process of installing the new Microwave Landing System (MLS) as part of the improved navigation and landing system and is studying advanced MLS-guided approaches. In order for current aircraft to achieve maximum advantage from the improved capability of MLS (e.g., curved or segmented approaches) at minimum cost, the FAA needs to identify existing avionics currently installed on various classes of aircraft which could be used as part of the advanced approach display and guidance system. Such data on specific equipage of various classes of aviation users has not been compiled before. This lack of data has prevented the development of comprehensive simulations to check out MLS approach concepts.

Currently the FAA's Cockpit Technology Program Office is working with NASA and the FAA Technical Center in developing scenarios for advanced approaches and simulations to test these scenarios. A necessary input into the scenario is the current avionic equipage of various classes of aircraft. RJO Enterprises, Inc. has been tasked by the Program Engineering and Maintenance Service (APM) at FAA Headquarters to compile data on the avionics that are now installed in various types of aircraft and that could be integrated with the MLS to support advanced approaches.

1.2 SCOPE

This report catalogs MLS-compatible avionics. It identifies specific equipment currently found in aircraft which could be used in conjunction with the MLS angle receiver during approach operations. Because of the diverse range of users which are candidates for the advanced approach concept, we developed a representative sample of each class of aircraft used by each group. The users under consideration include the commercial carriers, general aviation, and rotorcraft. The commercial carriers are divided into the major air carriers and the commuter and air taxi operators, called regional air carriers. The general aviation class is composed of cabin class aircraft and single engine and light twin engine aircraft. Rotorcraft constitutes a separate category because of this aircraft's unique flight capabilities. However, rotorcraft are combined into one group without regard to the user community (e.g., air taxi, corporate) to which they belong.

1.3 TECHNICAL APPROACH

We limited the aircraft considered as candidates for advanced approaches to those typically operating under Instrument Flight Rules (IFR) and equipped with adequate avionics to meet minimum IFR requirements. This category includes all aircraft which operate above eighteen thousand feet (FL 180), all aircraft operating under Parts 121 and 125, Title 14, Code of Federal Regulations (CFRs) and the majority of aircraft operating under Part 135. In addition, many aircraft operating under Part 91 are IFR certified and therefore included in the study.

We divided the study into major user categories and collected equipage data on each user. Major air carriers were contacted about specific equipment on every aircraft model in the inventory. We chose regional air carriers, including commuter and air taxi, on the basis of the number of passengers carried, and we asked the top 25 carriers for specific equipage of their fleets. We divided executive aircraft into turbo-jets and turbo-prop categories and obtained typical avionic equipage for each aircraft in the categories by contacting airframe manufacturers, avionic manufacturers, and FBOs (Fixed Base Operators). We also researched used aircraft sales publications and FAA avionic surveys. Further, we

developed the general aviation aircraft equipage by talking with airframe and avionic manufacturers and reviewing used aircraft sales publications and FAA avionic surveys. We developed the helicopter equipage on the basis of direct contact with manufacturers and user organizations.

We limited the avionics suitable for advance approaches to auto-pilots, flight directors, specific VHF navigation equipment, navigation displays, distance measuring equipment, and radar systems. We included instrument model numbers for most navigation display instruments. Other instrumentation model numbers for example, attitude direction indicators, can be derived from the associated avionic components where possible. Automatic direction finding (ADF) systems were also included throughout most of the study.

1.4 REPORT ORGANIZATION

This report presents the results of the study identifying aircraft equipage of navigation avionics organized by user groups.

Chapter One presents the background, scope, technical approach and organization of this report.

Chapter Two presents the avionic equipage of the air carriers and identifies avionics by aircraft type.

Chapter Three addresses the regional air carrier community equipage based on the top 25 regional carriers.

Chapter Four focuses on the executive jet fleet of aircraft.

Chapter Five describes the navigation capabilities of the general aviation aircraft. It is divided into two sections: (1) the twin engine cabin class of aircraft, and (2) the light twin engine and single engine aircraft.

Chapter Six presents the results of the helicopter community equipage study, limited to IFR certified helicopters.

Chapter Seven presents the conclusions of the study.

CHAPTER TWO

MAJOR AND NATIONAL AIR CARRIERS

2.1 INTRODUCTION

The air carrier fleet of the United States consists of 27 major and national air carriers as defined by the World Aviation Directory. The combined fleet operates 2443 aircraft comprising 15 types and all models within each aircraft type. The fleet consists of almost all pure jet equipment except for the Convair 580 and the DeHavilland DHC-7 turbo prop aircraft. The dominant aircraft in the inventory is the Boeing 727-200 with 783 aircraft in the fleet. Table 2-1 presents the summary by carrier, based on 1984 statistics compiled by the World Aviation Directory. Although new aircraft are scheduled for delivery to the carriers, and some models are planned for retirement or sale, the FAA does not expect the total population to change dramatically in the next few years.

Table 2-1 Summary of Aircraft Used By Major and National Air Carriers

Aircraft Type	Models	Manufacturer	Quantity in Service
B-727	-100, -200	Boeing	987
DC-9	-10/40, 50	McDonnell Douglas	435
B-737	-100, -200	Boeing	310
DC-10	-10, -30, -40	McDonnell Douglas	150
B-747	All	Boeing	128
L-1011	All	Lockheed	114
MD-80	All	McDonnell Douglas	86
DC-8	-50, -60, -70	McDonnell Douglas	81
B-767	All	Boeing	51
A-300	All	Airbus Industries	34
BAC-111	All	British Aerospace	26
B-757	All	Boeing	15
CV-580	All	Convair	15
DHC-7	All	DeHavilland	7
F-28	All	Fokker	4

2.2 DEVELOPMENT OF AVIONIC EQUIPAGE

We asked a representative sample of the air carrier community for data on the avionics equipage of their fleet of aircraft. During the data collection effort we examined potential variations among models within an aircraft type and discovered that most commercial airlines try to standardize avionics configurations for all of their own aircraft of the same type. Moreover, there are generally no differences in avionic configurations between similar models of aircraft within a fleet (e.g., B727-100 and 727-200).

Each airline contacted, furnished model and quantity data for each aircraft in its fleet covering the following avionic systems:

- Area Navigation Systems
- Flight Directors (FD)
- Flight Management Systems
- Integrated Flight Controls
- Distance Measuring Equipment
- Navigation Receivers
- Radar Systems
- Course Deviation Indicators (CDI)
- Horizontal Situation Indicators (HSI)
- Radio Magnetic Indicators (RMI)

The majority of the air carrier aircraft do not have VOR/DME-based Area Navigation Systems (RNAV) in their aircraft. Long-range aircraft, typically those involved in international flights, have Omega-based systems or inertial navigation systems that provide the area navigation capability. However, these navigation systems have not been listed in this report because they are not certified for non-precision approaches. All air carrier aircraft are equipped with flight directors (FDs) which are either a part of the auto pilot system or a separate system providing the FD function. Integrated flight control systems (IFCS) such as the Sperry SPZ 600/800 or Collins FCS-80 are typically reserved for corporate-class aircraft where a single manufacturer provides the auto pilot, flight director, and air data computer

components in a single integrated system. The large air carrier aircraft possess the capabilities provided by an IFCS but not necessarily in a single integrated system. The remaining navigation oriented avionics are typically stand-alone units, remotely mounted, with panel or pedestal mounted displays and controls.

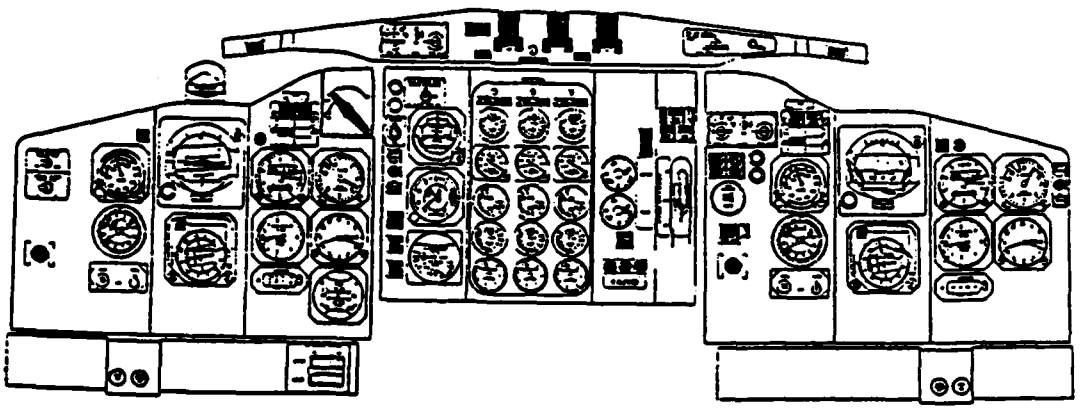
The majority of the major and national air carriers specify the Aeronautical Radio, Inc. (ARINC) characteristics (i.e., form, fit, function) for avionics used in their fleet of aircraft. This specification permits interchange of all manufacturers' equipment built to a specific ARINC characteristic and defines the external performance parameters of the avionics. This standardization will make it easy to interface the proposed advanced approach system with existing avionics.

2.3 AIR CARRIER AVIONIC EQUIPAGE

The typical air carrier aircraft is adequately equipped for IFR flights. They are operated by at least a two-man crew, pilot and copilot, usually with identical instruments for each. The aircraft contains two VOR navigation receivers, each driving an HSI with an RMI on the opposite position. DME information, whether derived from a single DME or dual system will drive an indicator usually configured as part of the HSI. Stand-alone indicators for DME are common and are often provided in addition to a DME readout integrated into the HSI. CDIs are usually not included in the panels. Weather radar information is displayed to the crew on either a single, center-mounted CRT, or, in the case of larger air frames, on two CRTs mounted on the lower panels near the fuselage. Cockpit panel space is very limited because engine performance indicators fill all available space outside of the conventional ADIs, VSIs, altimeters, and air speed indicators.

New generation aircraft incorporating the Electronic Flight Instrument Systems (EFIS) have much greater display flexibility based on the menu selected by the crew and must be treated separately.

Figures 2-1 through 2-10 present the results of the study by type of aircraft with typical avionic instrumentation. The figures list the total population of aircraft types in the U.S. air carrier fleet, the size of the sample used in this study, typical avionic models encountered in the fleet sample, pilot and copilot instrumentation, and any variations on typical configurations uncovered during the study. In addition a picture of the instrument panel shows the panel area on each aircraft type.



Manufacturer: Boeing
Number of Engines: 3 - Jet
Gross Weight: 160,000 - 191,000 lbs.
Number in Population: 987
Number in Sample: 281
Models: -100, -200

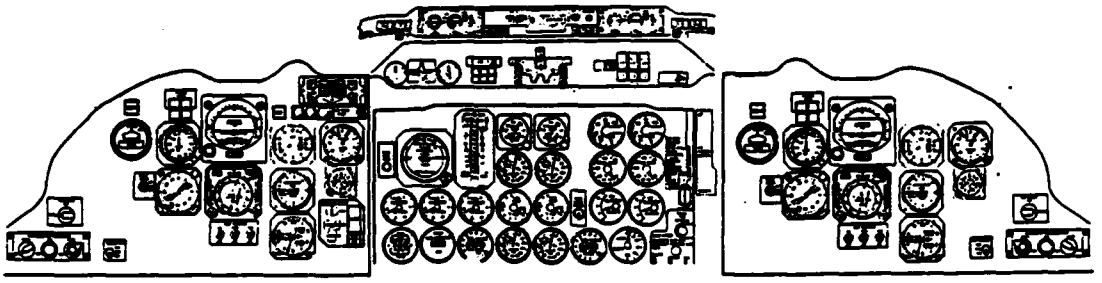
AVIONICS

FUNCTION	QUANTITY	MODELS
VOR Receiver	2/3	51RVI, 51RV2, 51RV4
DME	2	860E-2/4/5, KDM 7000
Weather Radar	1	WXR 700C, AVQ10, RDR-1E
Auto Pilot	1	SP 50/150
Flight Director	2	FD-109A, Z5, 614 E9C

INSTRUMENTS

FUNCTION	PILOT/MODEL	COMMON/MODEL	COPILOT/MODEL
HSI	1 Sperry 331 AGD	- -	1 Sperry 331 AGD
RMI	1 Bendix	- -	1 Bendix
CDI	0	- -	0
PPI	0	1 PPI/1G/M PPI-IU	0

Figure 2-1 Major Air Carrier Typical Equipage for B-727



Manufacturer: McDonnell Douglas
Number of Engines: 2-Jet
Gross Weight: 98,000 - 122,200 lbs.

Number in Population: 435
Number in Sample: 79
Models: -10/40, 50

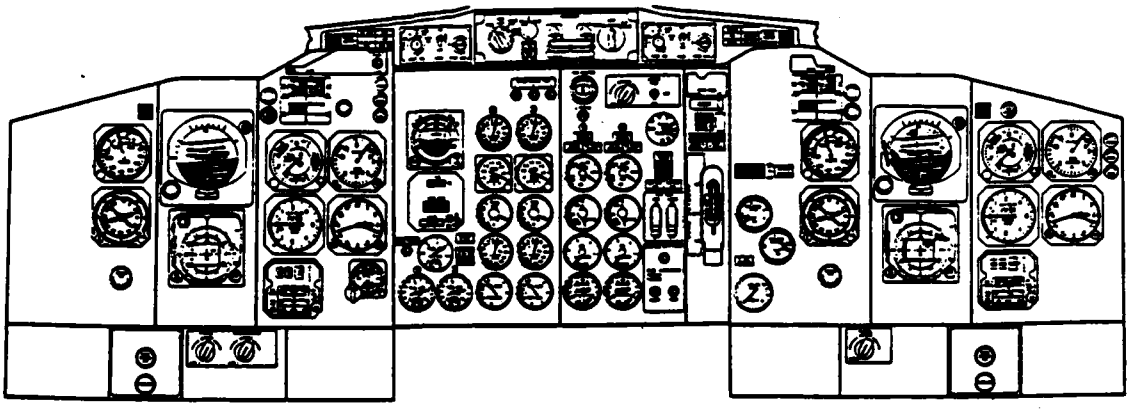
AVIONICS

Function	Quantity	Models
VOR Receiver	2-3	51RV-1, 51RV-2B, 51RV-4
DME	2	860 E-2/4
Weather Radar	1	RDR-1E
Auto Pilot	1	Sperry
Flight Director	2	614 E9C

INSTRUMENTS

Function	Pilot/Model	Common/Model	CoPilot/Model
HSI	1 331 A6D	- -	1 331 A6D
RMI	1 Sperry	- -	1 Sperry
CDI	0	- -	0
PPI	- -	PPI-1M/1G	- -

Figure 2-2 Major Air Carrier Typical Equipage for DC-9



Manufacturer: Boeing
Number of Engines: 2-Jet
Gross Weight: 111,000 - 125,000 lbs.

Number in Population: 310
Number in Sample: 49
Models: -100, -200

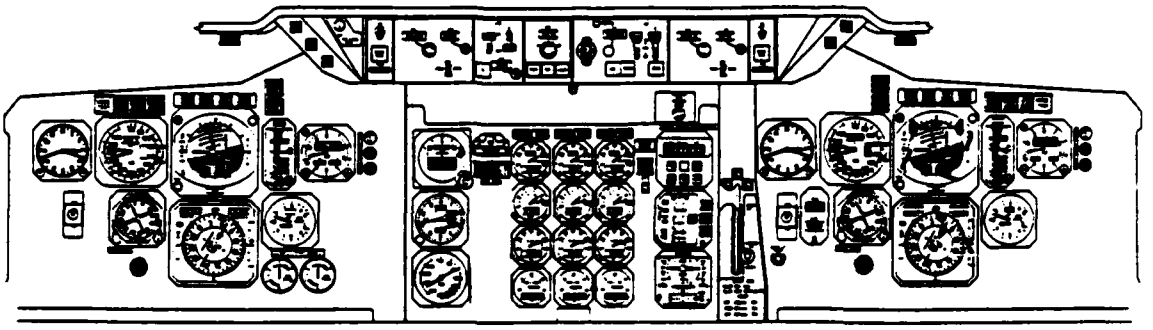
AVIONICS

Function	Quantity	Models
VOR Receiver	2	51RV2
DME	2	860E-2
Weather Radar	1	AVQ10
Auto Pilot	1	SP77
Flight Director	2	FD109A

INSTRUMENTS

Function	Pilot/Model	Common/Model	CoPilot/Model
HSI	1 Sperry	- -	1 Sperry
RMI	1 Bendix	- -	1 Bendix
CDI	0 -	- -	0 -
PPI	- -	1 (Pedestal)	- -

Figure 2-3 Major Air Carrier Typical Equipage for B-737



Manufacturer: McDonnell Douglas
Number of Engines: 3-Jet
Gross Weight: 455,000 lbs.

Number in Population: 150
Number in Sample: 50
Models: -10, -30, -40

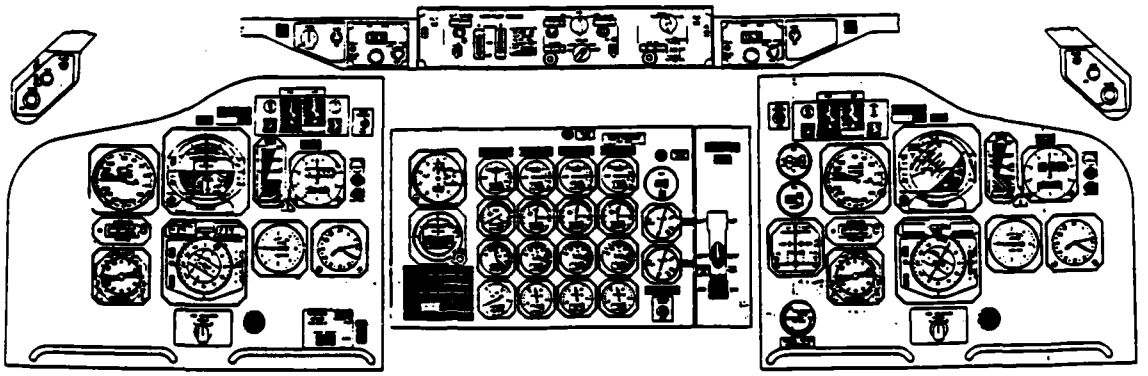
AVIONICS

Function	Quantity	Models
VOR Receiver	2	51RV2
DME	2	KDM7000
Weather Radar	1	WXR700C, AVQ30
Auto Pilot	2	PB100
Flight Director	2	P/O AP

INSTRUMENTS

Function	Pilot/Model	Common/Model	CoPilot/Model
HSI	1 Sperry	- -	1 Sperry
RMI	1 Sperry	- -	1 Sperry
CDI	0 -	- -	0 -
PPI	1 Left Panel	- -	1 Right Panel

Figure 2-4 Major Air Carrier Typical Equipage for DC-10



Manufacturer: Boeing
Number of Engines: 4-Jet
Gross Weight: 700,000 - 833,000 lbs.

Number in Population: 128
Number in Sample: 18
Models: All + SP

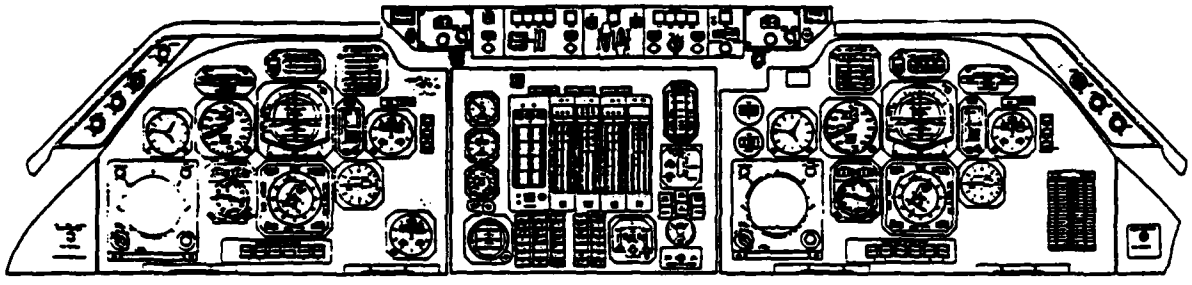
AVIONICS

Function	Quantity	Models
VOR Receiver	2	51RV2
DME	2	KDM 7000
Weather Radar	1	AVQ 30
Auto Pilot	3	SP31
Flight Director	3	P/O AP

INSTRUMENTS

Function	Pilot/Model	Common/Model	CoPilot/Model
HSI	1 Collins	- -	1 Collins
RMI	1 Sperry	- -	1 Sperry
CDI	0 -	- -	0 -
PPI	1 Left Panel	- -	1 Right Panel

Figure 2-5 Major Air Carrier Typical Equipage for B-747



Manufacturer: Lockheed
Number of Engines: 3 - Jet
Gross Weight: 430,000 - 496,000 lbs.
Number in Population: 114
Number in Sample: 24
Models: All + 500

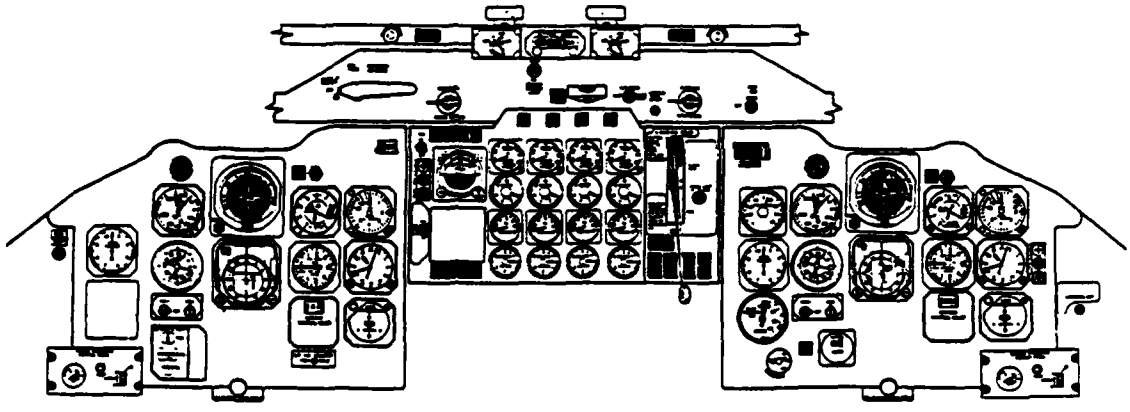
AVIONICS

Function	Quantity	Models
VOR Receiver	2	51R - 6/10A
DME	2	860E - 3/5
Weather Radar	2	RDR-1F
Auto Pilot	1	916 A-4
Flight Director	1	P/O AP (AFL)

INSTRUMENTS

Function	Pilot/Model	Common/Model	CoPilot/Model
HSI	1 Sperry	- -	1 Sperry
RMI	1 Sperry	- -	1 Sperry
CDI	0	- -	0
PPI	1 PPI-1T	- -	1 PPI-1T

Figure 2-6 Major Air Carrier Typical Equipage for L-1011



Manufacturer: McDonnell Douglas
Number of Engines: 4-Jet
Gross Weight: 315,000 - 325,000 lbs.

Number in Population: 81
Number in Sample: 41
Models: -50, -60, -70

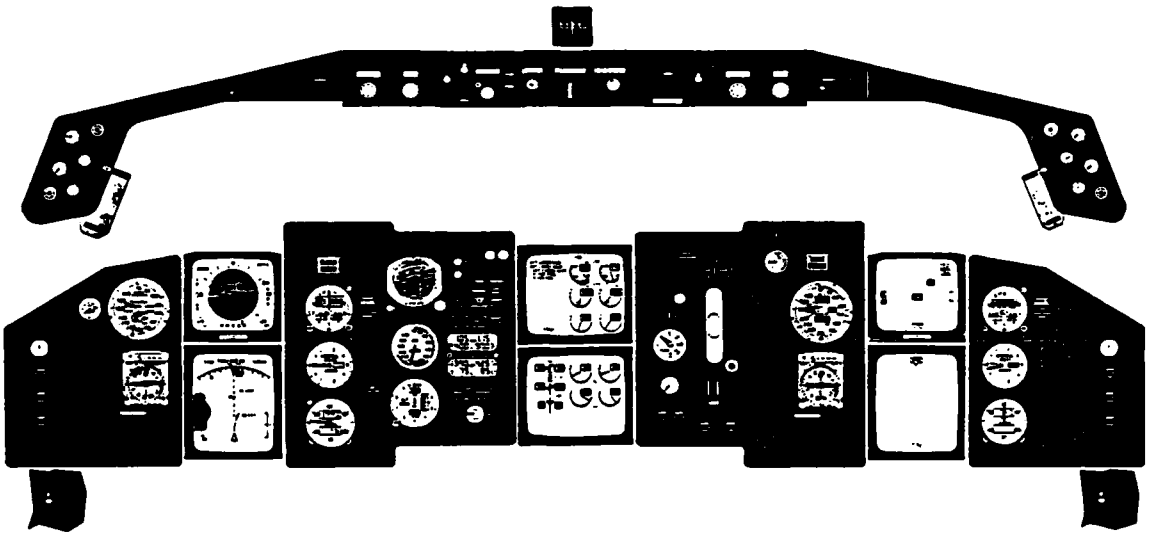
AVIONICS

Function	Quantity	Models
VOR Receiver	2	51RV2
DME	2	860E-2
Weather Radar	1	WXR700C
Auto Pilot	1	SP30AL
Flight Director	2	Z5

INSTRUMENTS

Function	Pilot/Model	Common/Model	CoPilot/Model
HSI	1 Sperry	- -	1 Sperry
RMI	1 Bendix	- -	1 Bendix
CDI	0 -	- -	0 -
PPI	- -	1 (Pedestal)	- -

Figure 2-7 Major Air Carrier Typical Equipage for DC-8



Manufacturer: Boeing
Number of Engines: 2-Jet
Gross Weight: 312,000 lbs.

Number in Population: 51
Number in Sample: 19
Models: All

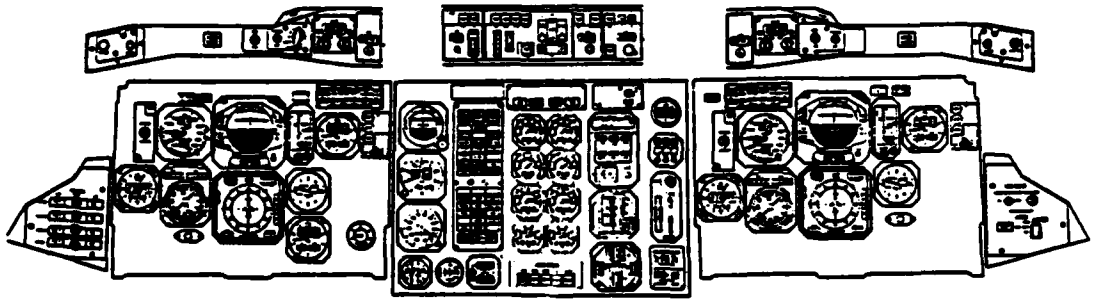
AVIONICS

Function	Quantity	Models
VOR Receiver	2	RVA-36
DME	2	DME 700
Weather Radar	1	WXR 700 C
Auto Pilot	3	FCS 700
Flight Director	3	P/O AP
FMS	2	FMS 944

INSTRUMENTS

Function	Pilot/Model	Common/Model	CoPilot/Model
HSI	1 EFIS	- -	1 EFIS
RMI	1 RDMI 743	- -	1 RDMI 743
CDI	- -	- -	- -
CRT	- -	1 EFIS	- -

Figure 2-8 Major Air Carrier Typical Equipage for B-767



Manufacturer: Airbus Industrie
Number of Engines: 2 - Jet
Gross Weight: 313,060 lbs.
Number in Population: 34
Number in Sample: 34
Models: A-300

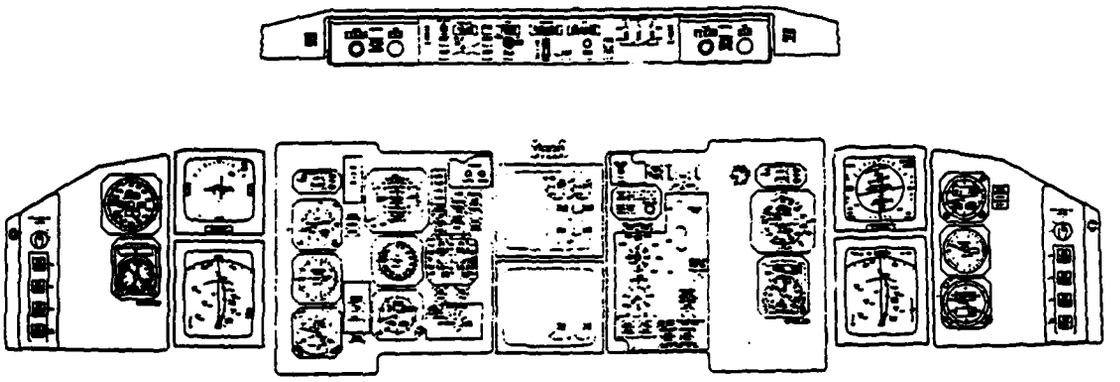
AVIONICS

FUNCTION	QUANTITY	MODELS
VOR Receiver	2	51R-6/10A
DME	2	860E-3/5
Weather Radar	2	RDR-IF
Auto Pilot	Not Available	-
Flight Director	Not Available	-

INSTRUMENTS

Function	Pilot/Model	Common/Model	CoPilot/Model
HSI	1 Sperry	- -	1 Sperry
RMI	1 Sperry	- -	1 Sperry
CDI	0	- -	0
PPI	1 PPI-1T	- -	1 PPI-1T

Figure 2-9 Major Air Carrier Typical Equipage for A-300



Manufacturer: Boeing
Number of Engines: 2-Jet
Gross Weight: 220,000 lbs.

Number in Population: 15
Number in Sample: 15
Models: 757-200

AVIONICS

Function	Quantity	Models
VOR Receiver	2	Bendix
DME	2	Bendix
Weather Radar	1	Bendix
Auto Pilot	Unknown	Collins
Flight Director	Unknown	P/O AP
FMS	2	Sperry

INSTRUMENTS

Function	Pilot/Model	Common/Model	CoPilot/Model
HSI	1 Collins EFIS	- -	1 Collins EFIS
RMI	1 RDMI-743	- -	1 RDMI-743
CDI	- -	- -	- -
CRT	- -	1 Collins EFIS	- -

Figure 2-10 Major Air Carrier Typical Equipage for B-757

CHAPTER THREE

REGIONAL AIR CARRIERS

3.1 INTRODUCTION

The Regional Airlines Association (RAA) is composed of commuter and large air taxi operations which typically supplement the major and national air carriers by feeding traffic to major hubs from smaller cities and rural airports. This type of operation usually requires smaller aircraft carrying anywhere from six to thirty passengers. These smaller aircraft are capable of operations from short runways. The RAA fleet is composed of all classes of aircraft from a single engine Piper Super Cub to the 4-Jet engine BA-146, and includes some aircraft typically found in the national air carrier fleets such as the DC-9, BAC 111 and F-28 jets. The top 25 regional air carriers, based on 1984 passenger enplanement data, account for 469 aircraft with the Cessna 402, Embrair EMB-110 and Fairchild METRO III the dominant airframes. The Cessna 402 has eight seats, the EMB-110 19, and the MERRO III 22. This passenger capacity is typical of the RAA operations.

3.2 DEVELOPMENT OF AVIONIC EQUIPAGE

We expect the avionic equipage of RAA aircraft to be similar to that carried by the major and national air carriers since the aircraft operate under similar flight rules. However, where the latter carriers specify ARINC characteristic equipment for their fleets, the RAA fleets usually equip with either panel-mounted or remote-mounted avionics designed for the smaller aircraft. The diversity of avionics available to the regional air carriers, and the limited area of operation for each regional airline, affect the type and quantity of avionics in each aircraft. Moreover, because most carriers do not use ARINC characteristics, specific avionic models must be identified to determine the flight guidance capability associated with each aircraft. For this reason, we contacted each of the top 25 carriers and obtained data based on a large sample for each type of aircraft.

3.3 RAA AVIONIC EQUIPAGE

The majority of RAA aircraft have the basic avionics needed for IFR flight plus other useful items such as radar, flight directors, and autopilots. However, many carriers do not include autopilot equipment because the average flight is short and does not require use of an autopilot; they thereby reduce the cost of certification and inspection of these systems. Area navigation (RNAV) equipment is typically not found on RAA aircraft, again because of the short flights. However, new generation aircraft, especially those that have the electronic displays (e.g., SF-340), or large aircraft suitable for longer flights (e.g., DHC-7) often include RNAV capability as part of the factory installed package.

Table 3-1 presents the distribution of aircraft found within the 25 top regional air carriers. Figures 3-1 through 3-26 present the avionics equipage for these aircraft. These figures are arranged in the descending order of Table 3-1 and use generic terminology for model identification. Because of the similarity in avionic equipage among the carriers researched for similar aircraft types we expect that the remaining RAA aircraft will be similarly equipped for each aircraft type operated by RAA members.

All aircraft reviewed were equipped with at least two navigation receivers (nine aircraft were found to carry a third receiver), 98 aircraft (21%) were equipped with the dual DMEs, seven aircraft (2%) did not carry DMEs, and the rest had one DME. The DME equipment varied from panel- mounted to ARINC characteristic equipment, but the distinctions were not based on aircraft type. All but five aircraft were equipped with radar systems ranging from monochrome to digitized color radar.

Table 3-1 Top 25 RAA Aircraft — By Population In Use

Aircraft Designation	Manufacturer	Population	Sample Size	Engines
C-402	Cessna	52	18	2-Piston
EMB-110 Bandeirante	Embraer	51	38	2-TP
SA-227 Metro III	Fairchild Aircraft	44	44	2-TP
SD 3-30 Shorts	Short Brothers	36	36	2-TP
SA-226 Metro II	Fairchild Aircraft	34	34	2-TP
SD 3-60 Shorts	Short Brothers	32	32	2-TP
DHC-6 Twin Otter	DeHavilland	29	29	2-TP
CV-580/640	Convair	29	26	2-TP
DHC-7 Dash 7	DeHavilland	26	26	4-TP
BE-99	Beech	23	23	2-TP
BE-1900	Beech	18	18	2-TP
F-27	Fokker B.V.	13	13	2-TP
F-28	Fokker B.V.	12	12	2-Jet
DC-3A	McDonnell Douglas	12	12	2-Piston
YS-11(A)	Nihon	9	9	2-TP
G-159(C)	Gulf Stream Aerospace	9	9	2-TP
Mohawk 298 (NORD-262)	Aerospatiale	8	8	2-TP
BAe 146	British Aerospace	6	6	4-Jet
BAC 111	British Aerospace	6	6	2-Jet
404 Martin	G. Glen L. Martin	6	6	2-Piston
DC-9	McDonnell Douglas	5	5	2-Jet
SF-340	Saab-Fairchild	3	3	2-TP
BAe 31 Jetstream	British Aerospace	2	2	2-TP
HS-748 Hawkers	British Aerospace	2	2	2-TP
Citation 1	Cessna	1	1	2-Jet
PA-18 Super Cub	Piper	1	1	1-Piston
	TOTALS	469	419	

Manufacturer: Cessna
Number of Engines: 2-Piston
Gross Weight: 6,850 lbs.

Number in Population: 52
Number in Sample: 18
Models: 402, 402A, 402B, 402C
402 Business Liner (II)
402 Utiliner (II)

AVIONICS

Function	% of Sample None	Single	Dual	Models
NAV	-	-	100	KX 175B, KN 53
DME	-	100	-	KN 65A, DME 63, KNS 80
ADF	-	100	-	KR 85, KR 87
RNAV	11	89	-	KNS 80, KNS-81
Auto Pilot	6	94	-	400B
Flight Director	-	-	-	- - -
IFC	-	-	-	- - -
Radar	11	89	-	RDR 160, ART 161A

INSTRUMENTS

Function	Pilot % of Sample/Models		CoPilot % of Sample/Models	
HSI	94	KI 525A	11	KI 525A
RMI	11	KI 229	11	KI 229
CDI	50	KI 209	17	KI 209

Figure 3-1 Regional Air Carrier Equipage for CESSNA 402

Manufacturer: Embraer
Number of Engines: 2-TP
Gross Weight: 13,007 lbs.

Number in Population: 51
Number in Sample: 38
Models: P1/41
EMB-110 (P1A)(P141)
(P2)(P2/41)
Bandeirante

AVIONICS

Function	% of Sample None	Single	Dual	Models
NAV	-	-	100	KN-53, KX 175B, VIR-351, VIR 30A
DME	-	95	5	KN 63, KN 65, DME 40, DME 451
ADF	-	97	3	KR 87, KR 85, 650A, 51Y-7
RNAV	53	47	-	KNS 81, ANS 351
Auto Pilot	100	-	-	- - -
Flight Director	100	-	-	- - -
IFC	100	-	-	- - -
Radar	-	100	-	WXR 200, RDR 130, RDR 160, RDR 1200

INSTRUMENTS

Function	Pilot % of Sample	Pilot Models	CoPilot % of Sample	CoPilot Models
HSI	100	KI 525, AIM, 331A-3G	47	KI 525, AIM, 331A-3G
RMI	95	KNI 582, 332 C-10, KNI 581	42	KNI 582, 332 C-10, KNI 581
CDI	76	KI 204, RAI 303C	24	RAI 303C

Figure 3-2 Regional Air Carrier Equipage for EMB-110 BANDEIRANTE

Manufacturer: Fairchild Aircraft Corp.
Number of Engines: 2-TP
Gross Weight: 14,500 lbs.

Number in Population: 44
Number in Sample: 44
Models: SA-227(AC)
METRO III (A)
Swearingen Merlin
Metro II
Similar Corp.
versions are Merlin
4 (A)(C)

AVIONICS

Function	% of Sample None	Single	Dual	Models
NAV	-	-	100	VIR-30A, CN 2012 A
DME	-	100	-	DME-40, DM 2031
ADF	-	77	23	ADF-60, DF2071 A
RNAV	89	11	-	NP 204/A, F-612
Auto Pilot	-	*	-	- - -
Flight Director	-	*	-	- - -
IFC	82	18	-	FDS-84
Radar	-	100	-	ART 23/A, ART 161A, RDR-160, RT-131A

* Integrated Flight Control (IFC) Systems include autopilot and flight director capabilities.

INSTRUMENTS

Function	Pilot % of Sample	Pilot Models	CoPilot % of Sample	CoPilot Models
HSI	100	HSI 84, IN 863, IN 881A, 331A-3F, 331A-3G	73	IN 863, IN 881A, 331A-3F, 331A-3G
RMI	57	332C, RMI 30, 31337	39	332C, RMI 30, 31337
CDI	48	IN 2014A, Collins 51337		IN 2014A, Collins

Figure 3-3 Regional Air Carrier Equipage for SA-227 METRO III

Manufacturer: Short Brothers
Number of Engines: 2-TP
Gross Weight: 22,900 lbs.

Number in Population: 36
Number in Sample: 36
Models: SD 3-30 (-200) SHORTS Sherpa

AVIONICS

Function	% of Sample None	Single	Dual	Models
NAV	-	-	100	VIR-30
DME	-	100	-	DME-40
ADF	-	100	-	ADF-60A
RNAV	100	-	-	- - -
Auto Pilot	-	*	-	- - -
Flight Director	-	*	-	FD-112
IFC	-	100	-	913 KIA
Radar	-	100	-	RDR 130/150/1100/1200 WXR 200A

* Integrated Flight Control (IFC) Systems include autopilot and flight director capabilities.

INSTRUMENTS

Function	Pilot % of Sample/Models		CoPilot % of Sample/Models	
HSI	100	FD 112	87	HSI-70, 331A-3G
RMI	100	RMI 36, 332 C-10	100	RMI-36, 332 C-10
CDI	0	-	0	-

Figure 3-4 Regional Air Carrier Equipage for SD 3-30 SHORTS

Manufacturer: Fairchild Aircraft Corp.
Number of Engines: 2-TP
Gross Weight: 12,500 lbs.

Number in Population: 34
Number in Sample: 34
Models: SA-226 (TC) Metro, Corporate Versions
Fairchild 300
Swearingen Merlin III & IV (A)

AVIONICS

Function	% of Sample None	Single	Dual	Models
NAV	-	-	100	VIR-30, VIR-30A, KX-175B
DME	-	100	-	KN65A, KN63, DME-40, KDM-706
ADF	-	100	-	ADF-60, ADF-60A, KR-85, KR-87, ADF-1
RNAV	100	-	-	- - -
Auto Pilot	100	-	-	- - -
Flight Director	41	59	-*	FD-112V
IFC	41	59	-	913 KIA
Radar	-	100	-	RD 160, RDR 231, RDR 232, PRIMUS 30

* Integrated Flight Control (IFC) Systems include autopilot and flight director capabilities.

Instruments

Function	Pilot % of Sample	Pilot Models	CoPilot % of Sample	CoPilot Models
HSI	85	331A-3, HSI770 C	12	HSI 770 C, 331A-3G
RMI	85	RMI 30, 3137	85	RMI 30, 3137, KI 229
CDI	15	KI 206	79	KI 206, KI 207, 331 H-3G

Figure 3-5 Regional Air Carrier Equipage for SA-226 METRO II

Manufacturer: Short Brothers
Number of Engines: 2-TP
Gross Weight: 26,000 lbs.

Number in Population: 32
Number in Sample: 32
Models: SD3-60 Shorts Tucano

AVIONICS

Function	% of Sample None	Single	Dual	Models
NAV	-	-	100	VIR-30A
DME	-	13	87	DME-40
ADF	-	100	-	ADF-60A
RNAV	100	-	-	- - -
Auto Pilot	-	*	-	- - -
Flight Director	-	*	-	- - -
IFC	-	100	-	FGC-65
Radar	-	100	-	WXR 200, WXR 220, RDR 1200

* Integrated Flight Control (IFC) Systems include autopilot and flight director capabilities.

INSTRUMENTS

Function	Pilot % of Sample/Models		CoPilot % of Sample/Models	
HSI	100	NSI 70	100	NSI 70
RMI	100	RMI 36	100	RMI 36
CDI	0	-	0	-

Figure 3-6 Regional Air Carrier Equipage for SD 3-60 SHORTS

Manufacturer: DeHavilland
Number of Engines: 2-TP
Gross Weight: 12,500 lbs.

Number in Population: 29
Number in Sample: 29
Models: DHC-6-200, DHC-6-300 Twin Otter

AVIONICS

Function	% of Sample None	Single	Dual	Models
NAV	-	-	100	KRN 600A, VIR-30, VIR-351
DME	21	79	-	DX 175, 1000 6A
ADF	10	90	-	DME 195, DME 40, DME 90, KN 65
RNAV	100	-	-	ADF 60, ADF 141, DF 200, DF 212C
Auto Pilot	90	*	-	- - -
Flight Director	90	*	-	- - -
IFC	90	10	-	SPZ 200
Radar	-	100	-	WXR 200, RDR 1200, RDR 160, Primus 10

* Integrated Flight Control (IFC) Systems include autopilot and flight director capabilities.

INSTRUMENTS

Function	Pilot % of Sample	Pilot Models	CoPilot % of Sample	CoPilot Models
HSI	41	332 AG3, 331A-3G, RD 440	28	KI 525A, RD 440
RMI	66	RMI 30, 210G, 332 C10	66	RMI 30, 210G, 332 C10
CDI	21	KNI 520	72	IN 331, 331H-3G, KI 206, KNI 520

Figure 3-7 Regional Air Carrier Equipage for DHC-6 TWIN OTTER

Manufacturer: Convair
Number of Engines: 2-TP
Gross Weight: est. 50,000 lbs.

Number in Population: 29
Number in Sample: 26
Models: 580s/600s/640s
CV-240/-340/-440
Turbo Prop Conversion
Convair-Liner
Metropolitan

AVIONICS

Function	% of Sample None	Single	Dual	Models
NAV	-	-	100	KN600, KNR634, RNA-26C 51X2, 51R1, 51RV-1, KNR-630
DME	-	100	-	KN-63, KDM 705A, KDM 706, 860E-2, SRU-7000
ADF	-	100	-	KR-85, KDF-805, KDF-806, 51Y-4 DFA-73
RNAV	100	-	-	- - -
Auto Pilot	92	8	0	Collins
Flight Director	81	19	-	FD-105
IFC	-	-	-	- - -
Radar	-	100	-	ART 161, RD 160, WXR 220A, AVA Q10

INSTRUMENTS

Function	Pilot % of Sample/Models		CoPilot % of Sample/Models	
HSI	100	Collins, King	88	Collins, King
RMI	100	KNI 582, IN-14BT	100	KNI 582, IN-14BT
CDI	15	KI 206, 329 P-1	15	KI 206, 329 P-1

Figure 3-8 Regional Air Carrier Equipage for CONVAIR 580/600/640

Manufacturer: De Havilland Aircraft of Canada, Ltd.
Number of Engines: 4-TP
Gross Weight: 44,000 lbs.

Number in Population: 26
Number in Sample: 26
Models: DHC-7 (100)
DASH-7

Note: De Havilland now producing DASH-8's

AVIONICS

Function	% of Sample None	Single	Dual	Models
NAV	-	-	100	VIR 31A, 51RV4
DME	-	-	100	DME 40
ADF	-	19	81	ADF 61, DF-206, KDF-805
RNAV	50	-	50	DAC 7000
Auto Pilot	42	58	-	SP 200
Flight Director	-	-	100	SPE 700
IFC	-	-	-	-
Radar	-	-	100	Primus 40, Primus 400

INSTRUMENTS

Function	Pilot % of Sample/Models		CoPilot % of Sample/Models	
HSI	100	RD 445, RD 550A	100	RD 445, RD 550A
RMI	100	RH 445	100	RH 445
CDI	0	-	0	-

Figure 3-9 Regional Air Carrier Equipage for DHC-7 DASH 7

Manufacturer: Beech
Number of Engines: 2-TP
Gross Weight: 11,300 lbs.

Number in Population: 23
Number in Sample: 23
Models: 99, B99, C99 Beech-99 Airliner/ Commuter

AVIONICS

Function	% of Sample None	Single	Dual	Models
NAV	-	-	100	KN53, KNR 600, KN 170, KN 175 NAV-122, NAV-11
DME	-	100	-	KN 62, KN 65, KN 63, DNE 190, DME 195
ADF	-	100	-	KR-85, KR-87, T-12D, ADF-141
RNAV	100	-	-	- - -
Autopilot	100	-	-	- - -
Flight Director	100	-	-	- - -
IFC	100	-	-	- - -
Radar	-	100	-	RDR 130, RDR 160, PRIMUS 20

INSTRUMENTS

Function	Pilot % of Sample	Pilot Models	CoPilot % of Sample	CoPilot Models
HSI	22	331A3-G	22	331A3-G
RMI	22	KI 229	0	
CDI	78	KI 204, KI 209, KI 207, KI 214 VOA-4, 5, 9	78	KI 204, KI 207, KI 209, KI 214, VOA-4, 5, 9

Figure 3-10 Regional Air Carrier Equipage for BEECH 99

Manufacturer: Beech
Number of Engines: 2-TP
Gross Weight: 16,000 lbs.

Number in Population: 18
Number in Sample: 18
Models: 1900 Airliner

AVIONICS

Function	% of Sample None	Single	Dual	Models
NAV	-	-	100	KN 53 (8 A/C have 3 units)
DME	-	100	-	KN 63
ADF	-	100	-	KR 87
RNAV	100	-	-	- - -
Auto Pilot	100	-	-	- - -
Flight Director	100	-	-	- - -
IFC	100	-	-	- - -
Radar	-	100	-	RDR 160

INSTRUMENTS

Function	Pilot % of Sample	Pilot Models	CoPilot % of Sample	CoPilot Models
HSI	100	KI-525A, RD-450	100	KI-525A, 331A-3G
RMI	56	7137, KI-229	56	7137, KI-229
CDI	44	KI 206	56	KI 206

Figure 3-11 Regional Air Carrier Equipage for BEECH 1900

Manufacturer: Fokker & Fairchild Indust.
Number of Engines: 2-TP
Gross Weight: 45,900 lbs.

Number in Population: 13
Number in Sample: 13
Models: F-27 (A)(B)(J)
Fokker F-27 Friendship
Fairchild/Hiller
Aircraft
FH-227, FH-27
New Version Fokker 50

AVIONICS

Function	% of Sample None	Single	Dual	Models
NAV	-	-	100	51RV4, 51RV1, VIR-30
DME	-	38	62	860E-4, 860E-5, DME-40
ADF	39	38	23	51Y7, 51Y3, 51Y4, ADF-30
RNAV	100	-	-	- - -
Auto Pilot	69	31	-	SEP 2, SP600
Flight Director	62	*	-	FD 109
IFC	62	23	15	FZ 500, SPZ-7000
Radar	8	92	-	RDR 1300

* Integrated Flight Control (IFC) Systems include autopilot and flight director capabilities.

INSTRUMENTS

Function	Pilot % of Sample	Pilot Models	CoPilot % of Sample	CoPilot Models
HSI	100	RD 650, 331A-3G, RD 444	100	RD 650A, 331A-3G, RD 444
RMI	100	Sperry, Bendix	100	Sperry, Bendix
CDI	0	-	0	-

Figure 3-12 Regional Air Carrier Equipage for F-27 FOKKER

Manufacturer: Fokker
Number of Engines: 2-Jet
Gross Weight: 73,000 lbs.

Number in Population: 12
Number in Sample: 12
Models: F-28 MK 1000, MK 2000 MK 3000, MK 4000 New Version is Fokker 100

AVIONICS

Function	% of Sample None	Single	Dual	Models
NAV	-	-	100	KNR 6030, 51RV-4B
DME	-	-	100	860 E-5
ADF	-	-	100	DF-206, 51V-7
RNAV	100	-	-	- - -
Auto Pilot	-	100	-	SEP-6
Flight Director	-	100	-	FD108
IFC	100	-	-	- - -
Radar	-	100	-	Primus 90, Bendix

INSTRUMENTS

Function	Pilot % of Sample/Models	CoPilot % of Sample/Models
HSI	100 HSI 45	100 HSI 45
RMI	100 C-14	100 C-14
CDI		

Figure 3-13 Regional Air Carrier Equipage for F-28 FOKKER

Manufacturer: McDonnell Douglas
Number of Engines: 2 Piston
Gross Weight: 25,200 lbs.

Number in Population: 12
Number in Sample: 12
Models: Unknown, Versions of DC-3 (A)

AVIONICS

Function	% of Sample None	Single	Dual	Models
NAV	-	-	100	51R-3, KX-175B
DME	-	100	-	AVQ-75, KN-63, KN-65A
ADF	-	100	-	T12-C, KR-85, R-30
RNAV	100	-	-	- - -
Auto Pilot	100	-	-	- - -
Flight Director	100	-	-	- - -
IFC	100	-	-	- - -
Radar	100	-	-	- - -

INSTRUMENTS

Function	Pilot % of Sample/Models		CoPilot % of Sample/Models	
HSI	17		0	
RMI	0		0	
CDI	100	.331A-2, 33 1A-5F, 888, KT 206	100	331A-2, KT 206, 888

Figure 3-14 Regional Air Carrier Equipage for DC-3(A)

Manufacturer: Nihon Aeroplane Manuf. Co.
Number of Engines: 2-TP
Gross Weight:

Number in Population: 9
Number in Sample: 9
Models: YS-11, YS-11A*

AVIONICS

Function	% of Sample None	Single	Dual	Models
NAV	-	-	100	51RV-1, RNA-26C
DME	-	100	-	860E-1, 860E-214
ADF	-	-	100	60A, 51Y3, 51Y4, DFA-73A1
RNAV	100	-	-	- - -
Auto Pilot	33	66	-	SP50F
Flight Director	-	100	-	Z-5, Z-14
IFC	-	-	-	- - -
• Radar	-	100	-	RDR-1E

INSTRUMENTS

Function	Pilot % of Sample	Pilot Models	CoPilot % of Sample	CoPilot Models
HSI	100	R1, MNR4A, 331A-3G	100	R1, MHR4A, 331A-3G
RMI	33	C-6A	33	C-6A
CDI	0		0	

* Out of production, limited product support is available through Mitsubishi

Figure 3-15 Regional Air Carrier Equipage for NIHON YS-11(A)

Manufacturer: Gulfstream Aerospace
Number of Engines: 2-TP
Gross Weight: 36,000 lbs.

Number in Population: 9
Number in Sample: 9
Models: G-159, G-159C
Gulfstream 1(C)
G-1

AVIONICS

Function	% of Sample None	Single	Dual	Models
NAV	-	-	100	VIR-31A, VIR-30A, 51RV1
DME	-	44	56	DME-40, KDF-705, 860E-2, AVQ-75, AVQ-85
ADF	11	-	89	KDF-8000, ADF-60, 51Y-4, 51Y-7A
RNAV	89	11	-	ANS-31
Auto Pilot	22	78	-	AP 103, AP 105
Flight Director	67	33	-	FD 108, FD 109
IFC	100	-	-	- - -
Radar	-	100	-	RDR 1201, WXR-200A, Primus 30 Primus 400

INSTRUMENTS

Function	Pilot % of Sample	Pilot Models	CoPilot % of Sample	CoPilot Models
HSI	89	Collins, Sperry	100	Collins, Sperry
RMI	89	Collins	89	Collins
CDI	0	-	0	-

Figure 3-16 Regional Air Carrier Equipage for G-159 GULFSTREAM I

Manufacturer: Aerospatiale
Number of Engines: 2-Piston
Gross Weight: 23,370 lbs.

Number in Population: 8
Number in Sample: 8
Models: Nord 262 Conversion
N-262
MOHAWK 298

AVIONICS

Function	% of Sample None	Single	Dual	Models
NAV	-	-	100	VIR-30A
DME	-	100	-	DME-40
ADF	-	100	-	ADF-60
RNAV	100	-	-	
Auto Pilot	100	-	-	
Flight Director	-	100	-	FD 112V
IFC	100	-	-	
Radar	-	100	-	Primus 40

INSTRUMENTS

Function	Pilot % of Sample/Models		CoPilot % of Sample/Models	
HSI	100	FD 112V	100	FD 112V
RMI	0	-	0	-
CDI	0	-	0	-

Figure 3-17 Regional Air Carrier Equipage for MOHAWK 298 (NORD 262 Conv.)

Manufacturer: British Aerospace
Number of Engines: 4-Jet
Gross Weight: 82,250/89,500 lbs.

Number in Population: 6
Number in Sample: 6
Models: BAe 146 (-100) (-200)

AVIONICS

Function	% of Sample None	Single	Dual	Models
NAV	-	-	100	KNR 6030, 51R-4
DME	-	-	100	KDM-7000B, SRO-7000
ADF	-	83	17	51Y-4, 51Y-7
RNAV	100	-	-	- - -
Auto Pilot	-	*	-	- - -
Flight Director	-	*	-	- - -
IFC	-	100	-	Smith 7405 UE 4-3
Radar	-	100	-	Primus 90

* Integrated Flight Control (IFC) Systems include autopilot and dlight director capabilities.

INSTRUMENTS

Function	Pilot % of Sample/Models	CoPilot % of Sample/Models
HSI	100 RD 700B	100 RD 700B
RMI	100 DB 100	100 DB 100
CDI	0	0

Figure 3-18 Regional Air Carrier Equipage for BAe 146

Manufacturer: British Aerospace
Number of Engines: 2-Jet
Gross Weight: 78,500 lbs.

Number in Population: 6
Number in Sample: 6
Models: BAC-111 (400) (475) (500)
One-eleven

AVIONICS

Function	% of Sample None	Single	Dual	Models
NAV	-	-	100	51RV1
DME	-	-	100	860E-2
ADF	-	-	100	51Y-4
RNAV	100	-	-	- - -
Auto Pilot	-	100	-	AP105, Elliot
Flight Director	-	17	83	FD108, 329 B-4A
IFC	-	-	-	- - -
Radar	-	83	17	RDR-1E, Primus 90

INSTRUMENTS

Function	Pilot % of Sample/Models		CoPilot % of Sample/Models	
HSI	83	331 AG	83	331 AG
RMI	100	Bendix	100	Bendix
CDI	17	331 A-4	17	331 A-4

Figure 3-19 Regional Air Carrier Equipage for BAC 111 ONE-ELEVEN

Manufacturer: Glen L. Martin Co.
Number of Engines: 2-Piston Radials
Gross Weight: Estimated 45,000 lbs.

Number in Population: 6
Number in Sample: 6
Models: Martin 404's

AVIONICS

Function	% of Sample None	Single	Dual	Models
NAV	-	-	100	51R-3
DME	-	100	-	860E-2
ADF	-	-	100	MN62A
RNAV	100	-	-	- - -
Auto Pilot	100	-	-	- - -
Flight Director	100	-	-	- - -
IFC	100	-	-	- - -
Radar	-	100	-	RDR-160

INSTRUMENTS

Function	Pilot % of Sample/Models	CoPilot % of Sample/Models
HSI	0	0
RMI	100 Bendix	100 Bendix
CDI	100 Bendix	100 Bendix

Figure 3-20 Regional Air Carrier Equipage for MARTIN 404

Manufacturer: McDonnell Douglas
Number of Engines: 2-Jet
Gross Weight: 121,000 lbs.

Number in Population: 5
Number in Sample: 5
Models: DC-9 Specifics Unknown

AVIONICS

Function	% of Sample None	Single	Dual	Models
NAV	-	-	100	51RV1
DME	-	-	100	860E-2
ADF	-	-	100	51Y4
RNAV	100	-	-	- - -
Auto Pilot	-	100	-	SP50A
Flight Director	-	100	-	FD108, FD109, Z-500
IFC	100	-	-	- - -
Radar	-	100	-	RDR-1E, Primus 90

INSTRUMENTS

Function	Pilot % of Sample/Models		CoPilot % of Sample/Models	
HSI	100	HZ-4, 329 B-7K, 359-8C	100	HZ-4, 32 9B-7K, 359-8C
RMI	100	C-6, Sperry	100	C-6, Sperry
CDI	100	R-1, 331A-6D, 331A-6K	100	R-1, 331A-6D, 331A-6K

Figure 3-21 Regional Air Carrier Equipage for DC-9

Manufacturer: Saab-Fairchild
Number of Engines: 2-TP
Gross Weight: 27,000 lbs.

Number in Population: 3
Number in Sample: 3
Models: SF-340

AVIONICS

Function	% of Sample None	Single	Dual	Models
NAV	-	-	100	KNR-634
DME	-	-	100	KDM-706A
ADF	-	100	-	KDF-806
RNAV (V-NAV)	-	100	-	VNI-80B
Auto Pilot	-	*	-	- - -
Flight Director	-	*	-	EFIS 86, FD-84
IFC	-	100	-	- - -
Radar	-	100	-	WXT-200A

* Integrated Flight Control (IFC) Systems include autopilot and flight director capabilities.

INSTRUMENTS

Function	Pilot % of Sample/Models	CoPilot % of Sample/Models
HSI	100 EFD 86	100 EFD 86, HSI-84
RMI	100 D3337L	100 D3337L
CDI	100 KI-204	0 -

Figure 3-22 Regional Air Carrier Equipage for SF-340 SAAB

Manufacturer: British Aerospace
Number of Engines: 2-TP
Gross Weight: 15,210 lbs.

Number in Population: 2
Number in Sample: 2
Models: BAe 31, 3100, Jetstream 31

AVIONICS

Function	% of Sample None	Single	Dual	Models
NAV	-	-	100	VIR 32
DME	-	100	-	DME 42
ADF	-	100	-	ADF 60A
RNAV	100	-	-	- - -
Auto Pilot	100	-	-	- - -
Flight Director	100	-	-	- - -
IFC	100	-	-	- - -
Radar	-	100	-	WXR 300

INSTRUMENTS

Function	Pilot % of Sample/Models		CoPilot % of Sample/Models	
HSI	100	Sperry	100	Sperry
RMI	100	RMI-36	100	RMI-36
CDI	0	-	0	-

Figure 3-23 Regional Air Carrier Equipage for BAe 31 JETSTREAM

Manufacturer: British Aerospace
Number of Engines: 2-TP
Gross Weight: 46,500 lbs.

Number in Population: 2
Number in Sample: 2
Models: HS 748 Hawkers

AVIONICS

Function	% of Sample None	Single	Dual	Models
NAV	-	-	100	51RV4
DME	-	100	-	860E-5
ADF	-	-	100	51Y7A
RNAV	100	-	-	- - -
Auto Pilot	-	100	-	- - -
Flight Director	-	100	-	FPZ-500
IFC	100	-	-	SPZ-500
Radar	-	100	-	RDR-1700

INSTRUMENTS

Function	Pilot % of Sample/Models		CoPilot % of Sample/Models	
HSI	100	RD 444	100	RD 444
RMI	100	AERO 3137	100	AERO 31/37
CDI	0	-	0	-

Figure 3-24 Regional Air Carrier Equipage for HS 748 HAWKER

Manufacturer: Cessna
Number of Engines: 2-Jet
Gross Weight: 11,850 lbs.

Number in Population: 1
Number in Sample: 1
Models: C-500 Citation 1

AVIONICS

Function	% of Sample None	Single	Dual	Models
NAV	-	-	100	VNS 41
DME	-	-	100	DMS 44
ADF	-	100	-	DFS 43
RNAV	100	-	-	- - -
Auto Pilot	-	100	-	FG 570
Flight Director	-	-	-	FGS 70
IFC	-	100	-	FGS 70
Radar	-	100	-	RDS 82

INSTRUMENTS

Function	Pilot % of Sample/Models		CoPilot % of Sample/Models	
HSI	100	FGS 70	100	FGS 70
RMI	100	API	202	API 202
CDI	0	-	0	-

Figure 3-25 Regional Air Carrier Equipage for CESSNA CITATION I

Manufacturer: Piper
Number of Engines: 1-Piston
Gross Weight: 1,750 lbs.

Number in Population: 1
Number in Sample: 1
Models: PA-18-150 Super Cub

AVIONICS

Function	% of Sample None	Single	Dual	Model
NAV	-	-	100+	612, 825, 122
DME	100	-	-	
ADF	100	-	-	
RNAV	100	-	-	
Auto Pilot	100	-	-	
Flight Director	100	-	-	
• IFC	100	-	-	
Radar	100	-	-	

INSTRUMENTS

Function	Pilot % of Sample/Models	CoPilot % of Sample/Models
HSI	100 DG 010	N/A
RMI	0 -	0 -
CDI	100 122	- -

Figure 3-26 Regional Air Carrier Equipage for PIPER SUPER CUB

CHAPTER FOUR

EXECUTIVE AIRCRAFT

4.1 INTRODUCTION

Many corporations in the United States own and operate aircraft intended primarily for transporting executives at times most suited to their needs. These aircraft range from cabin class twin-engine piston aircraft to multi-engined jets. This section addresses the corporate jet fleet and limits the aircraft types to non-air carrier models to avoid duplication of data on aircraft which are similarly equipped. The aircraft considered are twin-engine jet except the Falcon-50, a three-engine jet, with corporate seating for 20 or fewer passengers. The Falcon-50 is the only three-engine jet aircraft in this seating category. The FAA General Aviation Activity and Avionic Survey report of 1983 identifies 3996 active turbojet aircraft in this category, which excludes large aircraft.

4.2 RESEARCH OF AVIONIC EQUIPAGE

We found the avionic equipage of executive aircraft by reviewing airframe manufacturers' portfolios on recommended equipage, specifications for standard factory-installed equipment, used aircraft literature, and by asking avionic manufacturers about typical configurations for their products in the executive aircraft market. The results of the research are presented in the following section, grouped by aircraft models. The typical executive aircraft is well equipped with dual avionics, radar systems, and in many cases, area navigation capability using VOR/DME, Omega, or Loran-C. This study, however, only considers VOR/DME-based area navigation because it is now the only area navigation system approved for non-precision approaches.

4.3 EXECUTIVE AIRCRAFT AVIONIC EQUIPAGE

The aircraft considered in this study are primarily those manufactured by Cessna, Gates, Sabreliner, Gulfstream, Dassault, British Aerospace, and Canadair. The aircraft populations are identified in Table 4-1.

These companies manufacture the majority of corporate jet aircraft used in the United States. Figures 4-1 through 4-10 show the typical avionic equipage for these aircraft based on either the standard avionics installed by the airframe manufacturer or the recommended equipage for the intended class of service. The avionic models shown in the figures are typical of the systems found in these aircraft. Other avionics manufacturer's equivalent equipment may be substituted without changing the capability of the avionic suite. The customer often adds on area navigation system for RNAV, either VOR/DME based, Omega/VLF, Loran-C, or inertial navigation depending on intended use of the aircraft.

We have combined many models (e.g., Gates Learjet series) because of the similarity of avionics throughout the models. Where distinct variations occur (e.g., Dassault Falcons), each model is presented separately. Also, aircraft manufactured outside the U.S. (e.g., Dassault Falcon) are delivered without avionics and retrofitted to customer specifications at Dassault facilities in the U.S.

Table 4-1 Executive Jet Aircraft

Aircraft Type	Manufacturer	Population	Sample Size
Learjets Except 55	Gates Learjet	581	11
Lear 55's	Gates Learjet	103	2
Falcon 10	Dassault-Breguet	Unknown	6
Falcon 20	Dassault-Breguet	216	8
Falcon 50	Dassault-Breguet	82	Mfr Spec.
Sabreliners	Sabreliner Corp.	341	"
HS 125 Hawker	British Aerospace	Unknown	"
Challenger CL600/601	Canadair	Limited	"
Gulfstream II	Gulfstream Aerospace	250 +	"
Gulfstream III	Gulfstream Aerospace	150	"

Manufacturer: Gates Learjet
Number of Engines: 2-Jet
Gross Weight: 15,000 - 18,550 lbs.

Number in Population: 581
Number in Sample: 11
Models: 24,25,28,29,35A,36A

AVIONICS

Function	% of Sample None	Single	Dual	Models
NAV	-	-	100	VIR 30
DME	-	100	-	DME 40
ADF	-	100	-	ADF 60
RNAV		*		* Optional
Auto Pilot	-	100	-	Jet FC-110, FC-200
Flight Director	-	50	50	Sperry, Collins
IFC	100	-	-	- - -
Radar	-	100	-	Collins, Sperry, Bendix

INSTRUMENTS

Function	Pilot % of Sample/Models	CoPilot % of Sample/Models
HSI	100 -	100 -
RMI	100 -	100 -
CDI	0 -	0 -

Figure 4-1 Executive Jet Avionics Equipage for LEARJETS

Manufacturer: Gates Learjet
Number of Engines: 2-Jet
Gross Weight: 21,250 lbs.

Number in Population: 103
Number in Sample: 2
Models: 55, 55ER, 55LR

AVIONICS

Function	% of Sample None	Single	Dual	Models
NAV	-	-	100	VIR 30
DME	-	50	50	DME 40
ADF	-	50	50	ADF 60A
RNAV	-	100	-	GNS 500A, AD 612
Auto Pilot	-	100	-	Jet FC-550
Flight Director	-	-	100	Sperry, Collins
IFC	100	-	-	- - -
Radar	-	100	-	Primus

INSTRUMENTS

Function	Pilot % of Sample/Models		CoPilot % of Sample/Models	
HSI	100	Sperry, Collins	100	Sperry, Collins
RMI	100	-	100	-
CDI	0	-	0	-

Figure 4-2 Executive Jet Avionics Equipage for LEAR 55

Manufacturer: Dassault-Breguet
Number of Engines: 2-Jet
Gross Weight: 18,740 lbs.

Number in Population: UNK
Number in Sample: 6
Models: Falcon 10
Falcon 100

AVIONICS

Function	% of Sample None	Single	Dual	Models
NAV	-	-	100	VIR 30
DME	-	100	-	DME 40
ADF	-	100	-	ADF 60
RNAV				GNS 500
Auto Pilot	-	100	-	
Flight Director	-	100	-	
IFC	100	-	-	
Radar	-	100	-	

INSTRUMENTS

Function	Pilot % of Sample/Models		CoPilot % of Sample/Models	
HSI	100	Collins, Sperry	100	Collins, Sperry
RMI	100		100	
CDI				

Figure 4-3 Executive Jet Avionics Equipage for FALCON 10

Manufacturer: Dassault
Number of Engines: 2-Jet
Gross Weight: 30,650 lbs.

Number in Population: 216
Number in Sample: 8 plus Mfgr.
Models: Falcon C20, F20
Falcon 200

AVIONICS

Function	% of Sample None	Single	Dual	Models
NAV	-	-	100	VIR 30
DME	-	-	100	DME 40
ADF	-	100	-	ADF 60A
RNAV	-	100	-	GNS 500, LRN 85
Auto Pilot	-	100	-	- - -
Flight Director	-	-	100	- - -
IFC	100	-	-	- - -
Radar	-	100	-	RDR 1200

INSTRUMENTS

Function	Pilot % of Sample/Models	CoPilot % of Sample/Models
HSI	*	*
RMI	100	100
CDI		

* EFIS for 200, HSI for 20

Figure 4-4 Executive Jet Avionics Equipage for FALCON 20

Manufacturer: Dassault-Breguet
Number of Engines: 3-Jet
Gross Weight: 38,800 lbs.

Number in Population: 82
Number in Sample: Mfgr. Equipage
Models: Falcon 50

AVIONICS

Function	% of Sample None	Single	Dual	Models
NAV	-	-	100	VIR-30
DME	-	-	100	DME-40
ADF	-	100	-	ADF-60A
RNAV	-	100	-	VLF, LRN-85
Auto Pilot	-	100	-	- - -
Flight Director	-	100	-	- - -
IFC	100	-	-	- - -
Radar	-	100	-	RDR-1200

INSTRUMENTS

Function	Pilot % of Sample/Models	CoPilot % of Sample/Models
HSI	100	100
RMI	100	100
CDI	0	0

Figure 4-5 Executive Jet Avionics Equipage for FALCON 50

Manufacturer: Sabreliner Corp.
Number of Engines: 2-Jet
Gross Weight: 17,450 lbs.

Number in Population: 341
Number in Sample: Mfgr. Equipage
Models: 40(A)(R)(SE), 60, 65, 75(A)
Saberliner
NA-265(-40)(-60)(-70)(-40A)
NA-265-80 SABRE 75A

AVIONICS

Function	% of Sample None	Single	Dual	Models
NAV	-	-	100	VIR 30
DME	-	-	100	DME 40
ADF	-	100	-	ADF 60A
RNAV		*		* Optional LRN 85, GNS 500A LTN 72R
Auto Pilot	-	100	-	
Flight Director	-	100	-	
IFC	100	-	-	
Radar	-	100	-	WXR 300, Primus 400, RDR 1200

INSTRUMENTS

Function	Pilot % of Sample/Models	CoPilot % of Sample/Models
HSI	100	100
RMI	100	100
CDI	0	0

Figure 4-6 Executive Jet Avionics Equipage for SABRELINERS

Manufacturer: British Aerospace
Number of Engines: 2-Jet
Gross Weight: 25,500 lbs.

Number in Population: Unknown
Number in Sample: Mfgr. Equipage
Models: Hawker Siddeley
Beech BH-125 (-400A)(-600)
DH 125 (-1A)(-3A)(-3AR)
(-400)(-600)
HS-125-700
BAe-125-700 (-800)

AVIONICS

Function	% of Sample None	Single	Dual	Models
NAV	-	-	100	VIR 30
DME	-	100	-	DME 40
ADF	-	100	-	ADF 60
RNAV	-	*	-	* Optional
Auto Pilot	-	100	-	
Flight Director	-	100	-	
IFC	100	-	-	
Radar	-	100	-	

INSTRUMENTS

Function	Pilot % of Sample/Models	CoPilot % of Sample/Models
HSI	100	100
RMI	100	100
CDI	0	0

Figure 4-7 Executive Jet Avionics Equipage for HS 125 HAWKER

Manufacturer: Canadair
Number of Engines: 2-Jet
Gross Weight: 41,250 - 41,800 lbs.

Number in Population: Limited
Number in Sample: Mfgr. Equipage
Models: CL 600/601 Challenger

AVIONICS

Function	% of Sample None	Single	Dual	Models
NAV	-	-	100	VIR 30
DME	-	-	100	DME 40
ADF	-	100	-	ADF 60A
RNAV		*		* Optional RNAV, VLF
Auto Pilot	-	100	-	SPZ 600
Flight Director	-	100	-	SPI 500
IFC	100	-	-	- - -
Radar	-	100	-	- - -

INSTRUMENTS

Function	Pilot % of Sample/Models	CoPilot % of Sample/Models
HSI	100 RD 650	100 RD 650
RMI	100	100
CDI	0	0

Figure 4-8 Executive Jet Avionics Equipage for CL 600/601 CHALLENGER

Manufacturer: Gulfstream Aerospace
Number of Engines: 2-Jet
Gross Weight: 39,100

Number in Population: 250+
Number in Sample: Mfgr. Equipage
Models: Gulfstream II (-B)

AVIONICS

Function	% of Sample None	Single	Dual	Models
NAV	-	-	100	VIR 30
DME	-	-	100	DME 40
ADF	-	-	100	ADF 60
RNAV		*		* Optional RNAV, VLF
Auto Pilot	-	100	-	Sperry, Collins
Flight Director	-	-	100	Sperry, Collins
IFC	100	-	-	- - -
Radar	-	100	-	Sperry, Collins, Bendix

INSTRUMENTS

Function	Pilot % of Sample/Models	CoPilot % of Sample/Models
HSI	100 RD 650	100 RD 650
RMI	100	100
CDI	0	0

Figure 4-9 Executive Jet Avionics Equipage for GULFSTREAM II

Manufacturer: Gulfstream
Number of Engines: 2-Jet
Gross Weight: 68,700

Number in Population: 150
Number in Sample: Mfgr. Equipage
Models: Gulfsteam III

AVIONICS

Function	% of Sample None	Single	Dual	Models
NAV	-	-	100	
DME	-	-	100	
ADF	-	-	100	
RNAV		*		* Optional RNAV, VLF
Auto Pilot	-	100	-	SPZ 800
Flight Director	-	-	100	SPI 800
IFC	100	-	-	
Radar	-	100	-	Primus 800

INSTRUMENTS

Function	Pilot % of Sample/Models	CoPilot % of Sample/Models
HSI	100	100
RMI	100	100
CDI	0	0

* EFIS available (EDZ 800)

Figure 4-10 Executive Jet Avionics Equipage for GULFSTREAM III

CHAPTER FIVE

GENERAL AVIATION AIRCRAFT

5.1 INTRODUCTION

The general aviation group encompasses all types of aircraft, including those typically found in the air carrier group. However, for the purposes of this study, we limited the general aviation aircraft presented in this chapter to the twin-engine turboprop, twin-engine piston and the single engine aircraft suitable for IFR flight. We expect cabin class twin-engine aircraft typcially to be well equipped, exceeding the minimum required avionics for IFR operations. Systems typically found in these aircraft include autopilots, radar, flight directors, area navigation and integrated displays. The annual summary report "General Aviation Activity and Avionics Survey" estimates that these are 5037 active twin-engine turboprop and 24882 active twin-engine piston aircraft in the United States. Similarly, the report lists 164,173 active single engine aircraft. Of these groups we assumed all twin-engine aircraft to be IFR-equipped, and 50 percent of single engine aircraft to be IFR-equipped. These assumptions were based on a comparison of minimum recommended avionics for IFR operation and the statistics contained in the report on navigation equipage for these classes of aircraft.

5.2 DEVELOPMENT OF AVIONIC EQUIPAGE

We have enough data from aircraft resale publications and avionic manufacturers to identify the probable configuration of twin-engine aircraft, especially larger cabin-class twins. Therefore, we have compiled data for each aircraft type using several sources of information. Table 5-1 lists the aircraft that were evaluated, the estimated total population of each, the sample size researched, and the number manufactured since 1979. The latter is important because the newer craft have excellent avionics configurations; avionics manufacturers indicate that the majority of twin-engine aircraft built since 1979 are equipped with the manufacturers' recommended avionic suites. The aircraft owner typically specifies the avionic manufacturer, panel or remote mounting, and the RNAV or radar system.

Table 5-1 General Aviation Aircraft—Twin Engine Cabin Class

Aircraft	Manufacturer	Year End '84 Total Population	Since 1979	Number in Sample
		Turboprop		
200 Super King Air	Beech	1309	800	40
100 King Air	Beech	384	83	11
90 King Air	Beech	1659	525	45
425 Conquest I	Cessna	196	196	15
441 Conquest II	Cessna	332	254	10
Cheyenne I & II	Piper	808	501	19
Cheyenne III	Piper	108	108	8
Aero Commander	Rockwell/Gulfstream	Unknown	376	18
		Piston		
421 Golden Eagle	Cessna	1899	392	17
414 Chancellor	Cessna	1052	405	21
402	Cessna	1520	460	7
340	Cessna	1283	457	Mfr-Specs
303 Crusader	Cessna	284	284	Mfr-Specs
Mojave	Piper	37	37	1
Navajo/Chieftain	Piper	3827	1080	20
Aerostar 601-602	Piper	1004	420	10
B-60 Duke	Beech	596	105	8
B55/58 Baron	Beech	5711	1087	31

The light twins and single engine aircraft present a different problem in identifying typical equipage because of the diversity of available avionics, limitations of available panel space, and intended service of the aircraft. It is safe to assume that an IFR-equipped aircraft will have dual navigation receivers (or combined NAV/COM transceivers) with an ADF receiver and associated indicators. However, the indicators for navigation can be the integrated HSIs, which provide magnetic heading, glide slope deviation, and course deviation, and the radio magnetic indicator, which provides magnetic heading and dual radio bearings, or the less expensive and more popular combination of directional gyro's, ADF indicators, and CDIs that perform the same functions. Distance measuring equipment (DME) is becoming increasingly popular in smaller aircraft. However, DMEs are not mandatory for flight below 24,000

feet, where the majority of these aircraft fly. In trying to identify the probable equipage of these aircraft, we contacted the leading avionics manufacturers and obtained the total number of avionic units produced since 1970, by model number, year of introduction, and current status of the production. This information, together with the FAA avionic survey results, allowed us to estimate the probable configurations in the light-twin and single-engine aircraft.

5.3 GENERAL AVIATION AIRCRAFT AVIONIC EQUIPAGE

The twin-engine turboprop aircraft included in this section are all manufactured in the United States and used for corporate, business, or private passenger transport. They are designed to accommodate two pilots, although many can be flown with one, depending on the service provided. They are typically very well equipped with remotely mounted avionics, integrated flight controls, area navigation equipment, and radar systems. Every aircraft researched was fitted with integrated functions displayed on an HSI for the pilot, and many provided HSI displays for the co-pilot. A large sample included long range capability such as Omega or Loran-C navigation and HF communications, which indicates that these aircraft occassionally operate outside the continental United States. Figures 5-1 through 5-8 present the equipage for turboprop twin-engine aircraft based on the samples used in the study. It is expected that the majority of the aircraft in the total population will be comparably equipped.

The majority of twin-engine piston type aircraft evaluated are configured for single-pilot operation, with instruments on the left side of the panel only. The aircraft have dual navigation receivers, single DMEs and a single ADF. However, of the 134 aircraft evaluated, only 103 (or 77 percent) were equipped with an HSI on the pilot's side. The remainder used the less expensive combination of a directional gyro (DG) and separate CDI indicators. Review of the manufacturers' specifications for these aircraft showed that the DG configuration was the standard for the aircraft with HSIs offered as additional cost options. Thirty seven (37) percent of the cabin class twins were equipped with area navigation equipment while seventy three (73) percent had weather radar capability ranging from monochrome to digitized color displays. Figures 5-9 through 5-18 present the results of the research for cabin class

Manufacturer: Beech
Number of Engines: 2-TP
Models: 200, B200
Super King Air

Number in Population: 1309
Number Produced Since 1979: 800
Number in Sample: 40

AVIONICS

Function	% of Sample None	Single	Dual	Models
NAV	-	-	100	VIR-30, KNR-634, KFS-564
DME	-	82	18	DME-40, KDM-706
ADF	-	100	-	ADF-60, KDF-806
RNAV	50	50	-	KNC-610, AD-611, ANS-31
Auto Pilot	-	32*	-	AP-105
Flight Director	-	30*	-	FD-108
IFC	-	68	-	SPZ 200, STARS/SPI 400/500, KFC-300, FCS-80
Radar	30	70	-	RDR-1200, RDR-1300, Primus

* Integrated Flight Control (IFC) Systems include autopilot and flight director capabilities.

INSTRUMENTS

	Pilot			CoPilot		
Function	%Single	%Dual	Models	%Single	%Dual	Models
HSI	100	-	King,Collins, Sperry	100	-	King,Collins, Sperry
RMI	100	-	"	100	-	"
CDI	0	-		0	-	

Figure 5-1 G.A. Turboprop Equipage for BEECH 200 SUPER KING AIRS

Manufacturer: Beech
Number of Engines: 2-TP
Models: 100, A100, B100, Beech 100 King Air

Number in Population: 384
Number Produced Since 1979: 83
Number in Sample: 11

AVIONICS

Function	% of Sample None	Single	Dual	Models
NAV	-	-	100	VIR-30, KNR-660, KNR-661
DME	-	100	-	DME-40, KDM-705
ADF	-	100	-	ADF-60, KDF-806
RNAV	45	55	-	KNC-610, AD-611, ANS-31
Auto Pilot	27	9*	-	M4D, AP-105
Flight Director	-	*	-	- - -
IFC	-	64	-	SPZ 200A (Star IV), FCS-105 (FD-108/FD-109)
Radar	27	73	-	Primus, RDR-130, RDR-1200, 21 RDR-1300

* Integrated Flight Control (IFC) Systems include autopilot and flight director capabilities.

INSTRUMENTS

	Pilot			CoPilot		
Function	%Single	%Dual	Models	%Single	%Dual	Models
HSI	100	-	Collins,King, Sperry	100	-	Collins,King, Sperry
RMI	100	-	"	100	-	"
CDI	0	-		0	-	

Figure 5-2 G.A. Turboprop Avionics Equipage for BEECH 100 KING AIRS

Manufacturer: Beech
Number of Engines: 2-TP
Models: 90, A90, B90, C90, E90, F90

Number in Population: 1659
Number Produced Since 1979: 524
Number in Sample: 45

AVIONICS

Function	% of Sample None	Single	Dual	Models
NAV	-	-	100	VIR-30, KNR-634, KNR-665, KNR-631, KNR-630
DME	-	100	-	DME-40, KDM-705, KDM-706
ADF	-	100	-	ADF-60, KDF-806
RNAV	53	47	-	KNS-610, ANS-31, AD-611, ANS-351, 612
Auto Pilot	10	24*	-	H-14, M4D, AP-200
Flight Director	-	10*	-	FD-108
IFC	-	55	-	SPZ 200A/STARS/SI, KFC-300, CENTURY IV
Radar	24	76	-	WXR-300, RDR-130, Primus, RDR-160, RDR-150, RDR-1300, AVQ-55, RDR-140, RDR-1200, AVQ-21, KWX-50, AVQ-20

* Integrated Flight Control (IFC) Systems include autopilot and flight director capabilities.

INSTRUMENTS

	Pilot			CoPilot		
Function	%Single	%Dual	Models	%Single	%Dual	Models
HSI	100	-	Sperry,Century Collins,King	100	-	Sperry,Century, Collins,King
RMI	100	-	"	100	-	"
CDI	0	-		0	-	

Note: 9% of sample was equipped with panel mounted avionics (Collins, Microline and King Silver Crown)

Figure 5-3 G.A. Turboprop Avionics Equipage for BEECH 90 KING AIRS

Manufacturer: Cessna
Number of Engines: 2-TP
Models: 425 Conquest I

Number in Population: 196
Number Produced Since 1979: 196
Number in Sample: 15

AVIONICS

Function	% of Sample None	Single	Dual	Models
NAV	-	-	100	1048A
DME	-	100	-	1077
ADF	-	100	-	1046
RNAV	67	33	-	1000RNAV, 612, 616
Auto Pilot	-	25*	-	1000 AP, SP 200
Flight Director	-	10*	-	SPI-400, Sperry RD-450
IFC	-	55	10	1000 IFCS (FIS-70), (SPZ-500)
Radar	-	100	-	WXR 300C, RDR-160

* Integrated Flight Control (IFC) Systems include autopilot and flight director capabilities.

INSTRUMENTS

	Pilot			CoPilot		
Function	%Single	%Dual	Models	%Single	%Dual	Models
HSI	100	-	4 inch	20	-	3 inch
RMI	100	-	IN-404A	0	-	
CDI	100	-		0	-	

Figure 5-4 G.A. Turboprop Avionics Equipage CESSNA 425 CONQUEST I

Manufacturer: Cessna
Number of Engines: 2-TP
Models: 441 Conquest
441 Conquest II

Number in Population: 332
Number Produced Since 1979: 254
Number in Sample: 10

AVIONICS

Function	% of Sample None	Single	Dual	Models
NAV	-	-	100	1048A, VIR-32
DME	-	80	20	1077B, DME-42
ADF	-	100	-	1046A, ADF-60
RNAV	50	50	-	1079A, RNS-3500, Foster
Auto Pilot	-	*	-	- - -
Flight Director	-	*	-	- - -
IFC	-	100	-	1000 IFS (FIS-70), SPZ-500
Radar	-	100	-	RDR-160, RDR-230, RDR-1150, *Primus* 200, 300, WXR-200

* Integrated Flight Control (IFC) Systems include autopilot and flight director capabilities.

INSTRUMENTS

	Pilot			CoPilot		
Function	%Single	%Dual	Models	%Single	%Dual	Models
HSI	100		RD-450R	20	-	PN-101
RMI	100		IN-404A, RMI-30, IN-1004B	0	-	
CDI	100		IND-31C	0	-	

Figure 5-5 G.A. Turboprop Avionics Equipage for CESSNA 441 CONQUEST II

Manufacturer: Piper
Number of Engines: 2-TP
Models: PA-31T1, PA-31TA, Cheyenne (I)
PA-31T, PA-31T2 Cheyenne II (XL)

Number in Population: 808
Number Produced Since 1979: 501
Number in Sample: 19

AVIONICS

Function	% of Sample None	Single	Dual	Models
NAV	-	-	100	VIR-30, KNR-634
DME	-	84	16	DME-40, DME-451, KNS-80, KN-63, KDM-706
ADF	-	100	-	ADF-60A, KDF-806
RNAV	58	42	-	KNS-80, ANS-351, ANS-31G
Auto Pilot	-	5*	-	- - - M4D
Flight Director	-	*	-	- - -
IFC	-	95	-	KFC-250, KFC-350, M4DFD, SPZ 200 (STARS)
Radar	5	95	-	RDR-1100, RDR-1200, RDR-230HP, RDR-160, RDR-150, Primus 300

* Integrated Flight Control (IFC) Systems include autopilot and flight director capabilities.

INSTRUMENTS

Function	Pilot %Single	%Dual	Models	CoPilot %Single	%Dual	Models
HSI	100	-		10	-	
RMI	100	-		5	-	
CDI	0	-		100	-	

Figure 5-6 G.A. Turboprop Avionics Equipage for PIPER CHEYENNE I & II

Manufacturer: Piper
Number of Engines: 2-TP
Models: PA-42-720,
Cheyenne (A)(III)
PA-42-1000
Cheyenne 400LS

Number in Population: 108
Number Produced Since 1979: 108
Number in Sample: 8

AVIONICS

Function	% of Sample None	Single	Dual	Models
NAV	-	-	100	VIR-30
DME	-	100	-	DME-40
ADF	-	100	-	ADF-60A
RNAV	-	100	-	GNS-500
Autopilot	-	*	-	- - -
Flight Director	-	*	-	- - -
IFC	-	100	-	KFC-300, FCS-65
Radar	-	100	-	Primus 300, RDR 400

* Integrated Flight Control (IFC) Systems include autopilot and flight director capabilities.

INSTRUMENTS

	Pilot			CoPilot		
Function	%Single	%Dual	Models	%Single	%Dual	Models
HSI	100	-	5"	25	-	4"
RMI	100	-		12	-	
CDI	0	-		0	-	

Figure 5-7 G.A. Turboprop Avionics Equipage for PIPER CHEYENNE III

Manufacturer: Rockwell/Gulfstream Aerospace
Number in Population: Unknown
Number Produced Since 1979: 376
Number of Engines: 2-TP
Number in Sample: 18
Models: 680(Super) (E)(F)(FP)(FL) (FLP), 690 (A)(B)(C) Rockwell Commander 840, 900, 980, 1000 Commander

AVIONICS

Function	% of Sample None	Single	Dual	Models
NAV	-	-	100	VIR-30A, KNR-634, 665A
DME	-	100	-	KDM-705, 706, DME-40
ADF	-	100	-	KDF-800
RNAV	94	6	-	KNR-665, AD-612
Auto Pilot	-	11*	-	H-14
Flight Director	-	6*	-	FD-112
IFC	-	89	-	M4DFD, KFC-300, Spery, AP-106 (FD-112)
Radar	-	100	-	Primus 40, 300, KWX-40, RDR-1200, 1300, WXR-300

* Integrated Flight Control (IFC) Systems include autopilot and flight director capabilities.

INSTRUMENTS

Function	Pilot %Single	%Dual	Models	CoPilot %Single	%Dual	Models
HSI	100			100		
RMI	100			0		
CDI	0			0		

Figure 5-8 G.A. Turboprop Avionics Equipage for ROCKWELL COMMANDERS

Manufacturer: Cessna
Number of Engines: 2-Piston
Models: 421, 421(A)(B)(C), Eagle I, II, III Golden Eagle

Number in Population: 1899
Number Produced Since 1979: 392
Number in Sample: 17

AVIONICS

Function	% of Sample None	Single	Dual	Models
NAV	-	-	100	400 Serices, 1000 Series, KNR-630, 665, NAV-824
DME	-	100	-	RTA-477A, 1077B, KDM-706, KN-63, DME-890
ADF	-	100	-	1046A, 400, KDF-806
RNAV	65	35	-	KNR-665, 800, RN-479A
Auto Pilot	-	29*	-	400B, 800B
Flight Director	-	*	0	- - -
IFC	29	71	-	800B IFCS, KFC-200
Radar	29	71	-	Primus 20, RDR-160, RDR-150

* Integrated Flight Control (IFC) Systems include autopilot and flight director capabilities.

INSTRUMENTS

Function	Pilot %Single	%Dual	Models	CoPilot %Single	%Dual	Models
HSI	82	-		0	-	
RMI	82	-		6	-	
CDI	82	18		6	-	

Figure 5-9 General Aviation Avionics Equipage for CESSNA 421 GOLDEN EAGLE

Manufacturer: Cessna
Number of Engines: 2-Piston
Models: 414, 414 II, 414A Challenger

Number in Population: 1052
Number Produced Since 1979: 405
Number in Sample: 21

AVIONICS

Function	% of Sample None	Single	Dual	Models
NAV	-	-	100	485B, VIr-351, 1048A
DME	-	90	10	RTA-477A, 451
ADF	-	100	-	446A, 1046A
RNAV	61	29	10	ANS-351, KNS-80, 400B
Auto Pilot	-	11*	-	400B
Flight Director	-	11*	-	FD-112,
IFC	11	89	-	400B IFCS, KFC-200, 800B, Century IV
Radar	5	95	-	AVQ-47, RDR-160, 130, Primus-200

* Integrated Flight Control (IFC) Systems include autopilot and flight director capabilities.

INSTRUMENTS

	Pilot			CoPilot		
Function	%Single	%Dual	Models	%Single	%Dual	Models
HSI	100	-		0	-	
RMI	100	-		0	-	
CDI	100	-		0	0	

Figure 5-10 General Aviation Avionics Equipage for CESSNA 414 CHANCELLOR

Manufacturer: Cessna
Number of Engines: 2-Piston
Models: 402, 402A, 402B,
402C Businessliner
402C Utiliner

Number in Population: 1520
Number Produced Since 1979: 460
Number in Sample: 7

AVIONICS

Function	% of Sample None	Single	Dual	Models
NAV	-	-	100	400 Series, Silver Crown, Microline
DME	-	100	-	"
ADF	-	100	-	"
RNAV	86	14	-	"
Auto Pilot	-	86*	-	400B
Flight Director	-	*	-	"
IFC	86	14	-	400B IFCS
Radar	57	43	-	RDR-160

* Integrated Flight Control (IFC) Systems include autopilot and flight director capabilities.

INSTRUMENTS

	Pilot			CoPilot		
Function	%Single	%Dual	Models	%Single	%Dual	Models
HSI	57	-	-	0	-	-
RMI	50	-	-	0	-	-
CDI	57	43	-	0	-	-

Figure 5-11 General Aviation Avionics Equipage for CESSNA 402

Manufacturer: Cessna
Number of Engines: 2 Piston
Models: 340, 340 II, 340A II

Number in Population: 1283
Number Produced Since 1979: 457
Number in Sample: Mfgr. Specs.

AVIONICS

Function	% of Sample None	Single	Dual	Models
NAV	-	-	100	400 Series
DME	-	100	-	400 Series
ADF	-	100	-	400 Series
RNAV	-	100	-	400 Series
Auto Pilot	-	47*	-	400B
Flight Director	-	*	-	- - -
IFC	-	53	-	400B IFCS, 800B IFCS, FCS-810
Radar	30	70	-	RDR-160

* Integrated Flight Control (IFC) Systems include autopilot and flight director capabilities.

INSTRUMENTS

	Pilot			CoPilot		
Function	%Single	%Dual	Models	%Single	%Dual	Models
HSI	76	-	3 inch	0		
RMI	76	-	400 or 1000	0		
CDI	76	24	-	0		

Figure 5-12 General Aviation Avionics Equipage for CESSNA 340

Manufacturer: Cessna
Number of Engines: 2-Piston
Models: 303 Crusader

Number in Population: 284
Number Produced Since 1979: 284
Number in Sample: Mfgr. Specs.

AVIONICS

Function	% of Sample None	Single	Dual	Models
NAV	-	-	100	400 Series
DME	-	100	-	"
ADF	-	100	-	"
RNAV	-	100	-	"
Auto Pilot	-	53*	-	400B
Flight Director	-	*	-	- - -
IFC	-	47	-	400BIFCS
Radar	-	100	-	RDR-160, KWX-56, Primus 100

* Integrated Flight Control (IFC) Systems include autopilot and flight director capabilities.

INSTRUMENTS

	Pilot			CoPilot		
Function	%Single	%Dual	Models	%Single	%Dual	Models
HSI	100	-	400 Series	0		
RMI	50	-	"	0		
CDI	100	-	"	0		

Figure 5-13 General Aviation Avionics Equipage for CESSNA 303 CRUSADER

Manufacturer: Piper
Number of Engines: 2-Piston
Models: PA-31P-350
Mojave

Number in Population: 37
Number Produced Since 1979: 37
Number in Sample: 1

AVIONICS

Function	% of Sample None	Single	Dual	Models
NAV	-	-	100	KN-53, KNS-81
DME	-	100	-	KN-63
ADF	-	100	-	KR-87
RNAV	-	100	-	KNS-81
Auto Pilot	-	*	-	- - -
Flight Director	-	*	-	- - -
IFC	-	100	-	KFC-250
Radar	-	100	-	RDR-1150

* Integrated Flight Control (IFC) Systems include autopilot and flight director capabilities.

INSTRUMENTS

Function	Pilot %Single	%Dual	Models	CoPilot %Single	%Dual	Models
HSI	100	-		100	-	
RMI	100	-		100	-	
CDI	0	-		0	-	

Figure 5-14 General Aviation Avionics Equipage for PIPER MOJAVE

Manufacturer: Piper
Number of Engines: 2-Piston
Models: PA-31-310 Navajo
PA-31-325 Navajo CR
PA-31-350 Chiefian
PA-31P-425 Pressurized Navajo

Number in Population: 3827
Number Produced Since 1979: 1,080
Number in Sample: 20

AVIONICS

Function	% of Sample None	Single	Dual	Models
NAV	-	-	100	Silver, Miero
DME	-	100	-	"
ADF	-	100	-	"
RNAV	55	45	-	KNS-80, KNS-81, ANS-531
Auto Pilot	5	10*	-	KAP-200, H-14
Flight Director	-	*	-	- - -
IFC	-	85	-	KFC-200, Piper Altimatic V
Radar	15	85	-	RDR-150, RDR-160

* Integrated Flight Control (IFC) Systems include autopilot and flight director capabilities.

INSTRUMENTS

Function	Pilot %Single	%Dual	Models	CoPilot %Single	%Dual	Models
HSI	90	-		0	-	
RMI	60	-		0	-	
CDI	90	10		10	-	

Figure 5-15 General Aviation Avionics Equipage for PIPER NAVAJO and CHIEFTAIN

Manufacturer: Piper
Number of Engines: 2-Piston
Models: PA-60-600 Aerostar 600
PA-60-601B Aerostar 601B
PA-60(-601P) (-602P) (-700P)
Pressurized Aerostar 601

Number in Population: 1004
Number Produced Since 1979: 420
Number in Sample: 10

AVIONICS

Function	% of Sample None	Single	Dual	Models
NAV	-	-	100	KX-175, KN-53, VIR-351
DME	-	100	-	195, KN-65A, DME-451
ADF	-	100	-	DR-85, KR-87
RNAV	60	40	-	AD-500, KNS-81
Auto Pilot	-	10*	-	Century, KAP-
Flight Director	-	*	-	- - -
IFC	-	90	-	Century IV, KFC-200, Century V
Radar	20	80	-	RDR-160, RDR-150, KWX-40

* Integrated Flight Control (IFC) Systems include autopilot and flight director capabilities.

INSTRUMENTS

	Pilot			CoPilot		
Function	%Single	%Dual	Models	%Single	%Dual	Models
HSI	90	-		0		
RMI	90	-		0		
CDI	90	10		0		

Figure 5-16 General Aviation Avionics Equipage for PIPER AEROSTAR

Manufacturer: Beech
Number of Engines: 2-Piston
Models: Duke 60, A60
Duke (A60) (B60)

Number in Population: 596
Number Produced Since 1979: 105
Number in Sample: 8

AVIONICS

Function	% of Sample None	Single	Dual	Models
NAV	-	-	100	VIR-351, KX-165, KX-175, KN-53
DME	-	100	-	KN-53
ADF	-	100	-	DME-251, KN-65, KN-63, VDI-4
RNAV	62	38	-	KR-85, KR-87, ADF-650
Auto Pilot	13	13*	-	- - -
Flight Director	-	*	-	- - -
IFC	-	75	-	Century III, Century IV, Century 41
Radar	25	75	-	RDR-130, RDR-160, AVQ-50, KWX-60

* Integrated Flight Control (IFC) Systems include autopilot and flight director capabilities.

INSTRUMENTS

Function	Pilot %Single	%Dual	Models	CoPilot %Single	%Dual	Models
HSI	88	-	PN-101,KI-525	12	-	
RMI	88	-	KF-229,RMI-30			
CDI	88	12	KI-206,IND-351	12	-	

Figure 5-17 General Aviation Avionics Equipage for BEECH 60 DUKE

Manufacturer: Beech
Number of Engines: 2-Piston
Models: B-55, E-55, 58, 58P, 58 TC, Baron

Number in Population: 5711
Number Produced Since 1979: 1087
Number in Sample: 31

AVIONICS

Function	% of Sample None	Single	Dual	Models
NAV	-	-	100	MK12, VIR-351, KX-175, KX-165, KN-53, VIR-350, 2000
DME	-	100	-	KN-65, KN-60, DME-451, 2000
ADF	-	100	-	KR-87, KR-85, 2000
RNAV	65	35	-	ANS-351, KNS-81, KNS-80
Auto Pilot	16	19*	-	B-5, Century III,
Flight Director	-	*	-	- - -
IFC	-	65	-	KFC-200, Century IV
Radar	61	39	-	RDR-160, RDR-150, KWX-56

* Integrated Flight Control (IFC) Systems include autopilot and flight director capabilities.

INSTRUMENTS

	Pilot			CoPilot		
Function	%Single	%Dual	Models	%Single	%Dual	Models
HSI	65	-	KI-525, PN-101	0		
RMI	14	-	KI-229	0		
CDI	65	35	VOA-3, VOA-9, KI-206	0		

Figure 5-18 General Aviation Avionics Equipage for BEECH 55 and 58 BARON

Table 5-2 General Aviation Navigation Avionics Manufactured Since 1970

Function	Quantity Produced
Navigation Receiver	324,860
Distance Measuring Equipment	92,949
Area Navigation	26,196
Auto Pilots	43,954
Flight Directors	28,202
HSI	48,201
RMI	23,545
CDI	253,683

twin-engine piston aircraft. The avionic models listed are typical of the equipment installed in these aircraft. Comparable equipment from other manufacturers will be found in the total population and will not change the capability provided by the avionics. We found a variety of indicators during the research. The models are not shown because of the number of different units involved. However, since this class of aircraft uses various standard panel and equipage configurations, the CDI or RMI indicators are usually matched to the avionics and can be readily obtained from manufacturers' lists. Aircraft manufactured since 1979 are likely to be as well or better equipped than those in the limited sample.

The light twin and single-engine aircraft equipped for IFR operations primarily use panel-mounted avionics with single pilot instrumentation. We contacted King Radio, Collins, Sperry, and Narco, the dominant manufacturers of avionics for this class of aircraft, and obtained the avionic productions quantities manufactured since 1970. Table 5-2 lists the totals for these manufacturers in the areas of interest. Combining the information in Table 5-2 with data contained in the FAA General Aviation Activity and Avionics Survey report shows potential aircraft equipage if we assume that a majority of

the avionics manufactured are installed in aircraft operating under IFR conditions. The FAA report shows 70,713 aircraft in the single and light twin category have flown IFR. The remaining active aircraft (i.e., 109,841) are predominantly in the 1-3 seat single engine and 4 or over seat single engine category. The majority (95 percent) of the active twin engine aircraft have flown IFR and therefore we assume they have the proper equipment for IFR flight. Figure 5-19 shows the probable equippage of the single-engine and light twin-engine aircraft based on the IFR population and manufacturers' production quantities. Because of the diversity and age of some avionics, the models are not shown on the figure. However, a listing of suitable avionics produced by the major manufacturers is included in Volume II of this report. Additional manufacturers also produce avionic systems suitable to this class of aircraft, but may not have surfaced in these limited samples of aircraft data. The units produced by these manufacturers would increase the probable equipage percentage for both IFR and non-IFR aircraft.

Manufacturer: Various **Number in Population:** 70,713
Number of Engines: 1 to 2 Piston

AVIONICS

Function	% of Sample None	Single	Dual	Models
NAV	-	-	100	
DME	-	85	-	
ADF	-	100	-	
RNAV	80	20**	-	
Auto Pilot	20	60*	-	
Flight Director	-	*	-	
IFC	-	20	-	
Radar		Unknown		

* Integrated Flight Control (IFC) Systems include autopilot and flight director capabilities.

** Does not include avionics manufactured by other companies such as Foster, leading manufactures of RNAV.

INSTRUMENTS

Function	Pilot %Single	%Dual	Models	CoPilot %Single	%Dual	Models
HSI	30	-		0		
[illegible]I	1	-		0		
CDI	30	70		0		

Figure 5-19 General Aviation Light Twin Engine and Single Engine Avionics Equipage

CHAPTER SIX

ROTORCRAFT

6.1 INTRODUCTION

The rotorcraft fleet in the United States is currently approaching 9,500 aircraft that are used for passenger transport, law enforcement, and cargo applications. Helicopters primarily operate at low altitudes and in areas normally not accessible by fixed wing aircraft. Because the ATC was developed to manage aircraft in terminal areas and enroute airspace, the ATC system does not generally serve low flying aircraft. For this reason, a majority of the current rotorcraft operate under VFR conditions. However, IFR rotorcraft must abide by the same rules as fixed wing aircraft and therefore have similar avionics as the fixed wing counterparts. Because this study focuses on aircraft which operate in instrument meteorological conditions (IMC) in the terminal environment, we have concentrated our efforts on rotorcraft that are currently IFR-certified and contain navigation equipment suitable for advanced approaches.

6.2 DEVELOPMENT OF ROTORCRAFT AVIONIC EQUIPAGE

TRIAD Engineering, Inc. under contract to RJO Enterprises, Inc. was tasked to develop the avionic suite common to IFR certified rotorcraft. Because of the dispersement of rotorcraft throughout the United States it was impossible to collect accurate data through contact with each owner. Therefore, TRAID had to talk with the airframe manufacturers and rotorcraft fleet operators and obtain their recommendations for avionic equipage.

Sixteen manufacturers of rotorcraft account for 9450 units flying in the U.S. Eight of these manufacturers account for 88 percent of the total population and were selected for analysis in this study. Table 6-1 identifies these manufactures, the number of helicopters in the U.S. fleet, and the number of helicopters that are IFR-certified. On the basis of manufacturers' data at the time of rotorcraft delivery,

only seven percent of the population is IFR certified. Additional units could be IFR certified by companies involved in customizing and equipping helicopters after sale. We talked with two such companies and confirmed the concept of IFR equipage, but these companies did not maintain records on numbers or types involved. One company indicated an average of five helicopters retrofitted every year.

Table 6-1 Helicopter Population in U.S. Fleet

Manufacturer	No. of Units	Number IFR Certified*
Aerospatiale	735	84
Agusta	45	40
Bell	4430	294
Boeing	3	3
Hiller	800	0
Hughes	1625	0
MBB	110	0
Sikorsky	600	160
TOTALS	8348	581

* Certification data based on manufacturers information at time of delivery

6.3 ROTORCRAFT AVIONIC EQUIPAGE

The five rotorcraft manufacturers that offer IFR-certified units provided avionics equipage data for the aircraft in their inventory. Aerospatiale produces eight helicopter models that have been IFR-certified — three of these models have a very small percentage (i.e., less than four percent) of the helicopters certified, while the other five models are 100 percent IFR-certified. Data was available on six of the Aerospatiale models and is included in this study. Agusta manufactures two models, the majority of which are IFR certified. Bell Helicopters has five models certified for IFR operations: one model has five percent of its helicopters certified for IFR flight, the second has 70 percent, the third has 90 percent, the fourth has 95 percent and the fifth has 100 percent. Only the four models with over five percent

certified were included in this report. Boeing Vertol has delivered only three helicopters for use in the U.S. All are IFR certified and included in this study. Sikorsky's main civilian production helicopter is the S-76 which is used for off-shore oil exploration, corporate transportation, and commercial applications. Most of the S-76 helicopters are IFR-certified.The Sikorsky S-61 and S-62 helicopters are predominantly flown VFR and are not included in the study.

Table 6-2 shows the helicopter population by model number, manufacturer, use, and quantities in service that are IFR certified. Figures 6-1 through 6-14 identify the avionic equipage of each model based on the factory recommended or installed avionics at time of delivery. Modifications or additions by individuals or fleet operators after delivery are not known.

Table 6-2 IFR Certified Rotorcraft

Model	Manufacturer	Service	Population
330 Puma	Aerospatiale	Commercial	15
332 Super Puma	Aerospatiale	Commercial	5
350 Astar	Aerospatiale	Commercial	7
355 Twin Star	Aerospatiale	Commercial	5
365 Daulphin II	Aerospatiale	Corporate	18
366 Daulphin II	Aerospatiale	USCG	12
109A & 109A-II	Agusta	Corporate	40
212	Bell	Commercial	119
214 ST	Bell	Commercial	20
222	Bell	Commercial	71
412	Bell	Commercial	54
234 Chinook	Boeing Vertol	Commercial/Oil	3
S-76	Sikorsky	Corporate	51
S-76	Sikorsky	Offshore Oil	86
	TOTAL		506

Manufacturer: Aerospatiale
Type of Service: Commercial
Model: 330 Puma

Number in Population: 15
Number IFR Certified: 15

AVIONICS

Function	% of Sample None	Single	Dual	Models
NAV	-	-	100	VIR-32
DME	-	-	100	DME-42
ADF	-	100	-	ADF-60
RNAV	-	100	-	Loran-C & RNAV
Auto Pilot	-	100	-	SFIM AP 155P
Flight Director	-	100	-	SFIM FDC 85
IFC	-	-	-	
Radar	-	100	-	Primus 400

INSTRUMENTS

Function	Co-Pilot Models	Pilot Models
HSI	0	SFIM
RMI	SFIM	0
CDI		

Figure 6-1 IFR Rotorcraft Equipage for AEROSPATIALE 330 PUMA

Manufacturer: Aerospatiale
Type of Service: Commercial
Model: 332 Super Puma

Number in Population: 5
Number IFR Certified: 5

AVIONICS

Function	% of Sample None	Single	Dual	Models
NAV	-	-	100	VIR-32
DME	-	-	100	DME-42
ADF	-	100	-	ADF-60
RNAV	-	100	-	ANS-31
Auto Pilot	-	100	-	SFIM AP 155P
Flight Director	-	100	-	FDC 85
IFC	-	-	-	- - -
Radar	-	100	-	Primus 400

INSTRUMENTS

Function	Co-Pilot Models	Pilot Models
HSI	0	SFIM
RMI	SFIM	0
CDI		

Figure 6-2 IFR Rotorcraft Equipage for AEROSPATIALE 332L1 SUPER PUMA

Manufacturer: Aerospatiale
Type of Service: Commercial
Model: 350D ASTAR
350B Ecurevil

Number in Population: 250
Number IFR Certified: 7

AVIONICS

Function	% of Sample None	Single	Dual	Models
NAV	-	-	100	VIR-351, KN-53
DME		*		*KNS-80 optional
ADF	-	100	-	ADF-650, KR-87
RNAV	-	-	-	- - -
Auto Pilot	-	100	-	SP-711, PC-702
Flight Director	-	-	-	FZ-702
IFC	-	-	-	- - -
Radar	100	-	-	- - -

INSTRUMENTS

Function	Co-Pilot Models	Pilot Models
HSI	0	RD-550, KI-525A, 331A-36
RMI	0	- - -
CDI	0	IND-350, KI-203

Figure 6-3 IFR Rotorcraft Equipage for AEROSPATIALE 350D A STAR

Manufacturer: Aerospatiale
Type of Service: Commercial
Model: 355F2 Twin Star

Number in Population: 162
Number IFR Certified: 5

AVIONICS

Function	% of Sample None	Single	Dual	Models
NAV	-	-	100	VIR-351, KN-53
DME	-	*	-	*KNS-80 optional
ADF	-	100	-	ADF-650, KR-87
RNAV	-	*	-	KNS-80 optional
Auto Pilot	-	100	-	SP-711, PC-702
Flight Director	-	100	-	FZ-702
IFC	-	-	-	- - -
Radar	100	-	-	- - -

INSTRUMENTS

Function	Co-Pilot Models	Pilot Models
HSI	0	RD-550, KI-525A, 331A-36
RMI	0	- - -
CDI	0	IND-350, KI-203

Figure 6-4 IFR Rotorcraft Equipage for AEROSPATIALE 355F2 TWIN STAR

AD-A170 793 AIRCRAFT AVIONICS SUITABLE FOR ADVANCED APPROACH APPLICATIONS VOLUME I AI..(U) RJO ENTERPRISES LANHAM MD S KOWALSKI ET AL. JUL 86 DOT/FAA/PM-86-25/1 2/2

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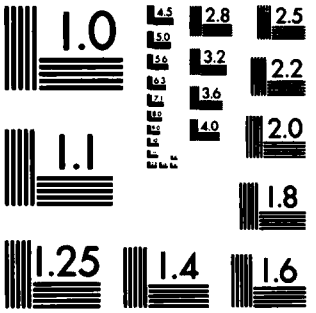

Manufacturer: Aerospatiale
Type of Service: Commercial
Model: 365 Daulphin II

Number in Population: 18
Number IFR Certified: 18

AVIONICS

Function	% of Sample None	Single	Dual	Models
NAV	-	-	100	VIR-31H
DME	-	100	-	DME-40
ADF	-	100	-	ADF-60
RNAV	100	-	-	- - -
Auto Pilot	-	*	-	AD-155D
Flight Director	-	*	-	MS-703
IFC	-	100	-	AFCS, FC-500
Radar	-	-	-	- - -

* Integrated Flight Control (IFC) includes an autopilot and flight director.

INSTRUMENTS

Function	Co-Pilot Models	Pilot Models
HSI	-	HSI-650A, RD-650A
RMI	-	RMI-30
CDI	-	-

Figure 6-5 IFR Rotorcraft Equipage for AEROSPATIALE 365 DAULPHIN II

Manufacturer: Aerospatiale
Type of Service: U.S. Coast Guard
Model: 366 Daulphin II

Number in Population: 12
Number IFR Certified: 12

AVIONICS

Function	% of Sample None	Single	Dual	Models
NAV	-	-	100	VIR-30
DME	-	-	100	DME-40
ADF	-	100	-	ADF-60
RNAV	100	-	-	- - -
Auto Pilot	-	100	-	CMS-80
Flight Director	-	100	-	CMS-80
IFC	-	-	-	
Radar	-	100	-	Bendix RDR

INSTRUMENTS

Function	Co-Pilot Models	Pilot Models
HSI	RD-650A	RD-650A
RMI	RH-404	RH-404
CDI		

Figure 6-6 IFR Rotorcraft Equipage for AEROSPATIALE 366 DAULPHIN II

Manufacturer: Agusta
Type of Service: Corporate
Models: A109A, 109AII

Number in Population: 45
Number IFR Certified: 40

AVIONICS

Function	% of Sample None	Single	Dual	Models
NAV	-	-	100	VIR-31A
DME	-	100	-	DME-40
ADF	-	100	-	ADF-60
RNAV	100	-	-	- - -
Auto Pilot	-	*	-	SP-711
Flight Director	-	*	-	FZ-702
IFC	-	100	-	SPZ-7000
Radar				

* Integrated Flight Control (IFC) Systems include autopilot and flight director capabilities.

INSTRUMENTS

Function	Co-Pilot Models	Pilot Models
HSI	-	RD-444
RMI	-	RH-404
CDI		

Figure 6-7 IFR Rotorcraft Equipage for AGUSTA 109A (II)

Manufacturer: Bell
Type of Service: Commercial
Model: 212

Number in Population: 170
Number IFR Certified: 119

AVIONICS

Function	% of Sample None	Single	Dual	Models
NAV	-	-	100	KNR-635
DME	-	100	-	KDM-706
ADF	-	100	-	KDF-806
RNAV	100	-	-	- - -
Auto Pilot	-	100	-	AGCS-212
Flight Director	-	-	-	- - -
IFC	-	-	-	- - -
Radar	100	-	-	- - -

INSTRUMENTS

Function	Co-Pilot Models	Pilot Models
HSI	0	Aeronautics 111302-5
RMI	0	0
CDI	0	0

Figure 6-8 IFR Rotorcraft Equipage for BELL 212

Manufacturer: Bell
Type of Service: Commercial
Model: 214ST Super Transport

Number in Population: 20
Number IFR Certified: 20

AVIONICS

Function	% of Sample None	Single	Dual	Models
NAV	-	100	-	KNR-634
DME	-	100	-	KDM-706
ADF	-	100	-	KDF-802
RNAV	-	100	-	KNS-81
Auto Pilot	-	100	-	AFCS-214ST
Flight Director	-	100	-	FZ-702
IFC	-	-	-	- - -
Radar				

INSTRUMENTS

Function	Co-Pilot Models	Pilot Models
HSI	Sperry	Astronautics
RMI	-	KDA-697
CDI	-	0

Figure 6-9 IFR Rotorcraft Equipage for BELL 214 SUPER TRANSPORT

Manufacturer: Bell
Type of Service: Commercial
Model: 222

Number in Population: 75
Number IFR Certified: 71

AVIONICS

Function	% of Sample None	Single	Dual	Models
NAV	-	-	100	VIR-351, KN-53
DME	-	100	-	DME-451, KN-63
ADF	-	100	-	ADF-650A, KR-87
RNAV	100	-	-	- - -
Auto Pilot	-	100	-	SHZ-222
Flight Director	-	100	-	FZ-702
IFC	-	-	-	- - -
Radar	100	-	-	- - -

INSTRUMENTS

Function	Co-Pilot Models	Pilot Models
HSI	0	Sperry, King, Astronautics
RMI	0	Sperry, King
CDI	King, Sperry	Sperry, King

Figure 6-10 IFR Rotorcraft Equipage for BELL 222

Manufacturer: Bell
Type of Service: Commercial
Model: 412

Number in Population: 60
Number IFR Certified: 54

AVIONICS

Function	% of Sample None	Single	Dual	Models
NAV	-	-	100	KNR-634
DME	-	100	-	KDM-706
ADF	-	100	-	KDF-806
RNAV	100	-	-	- - -
Auto Pilot	-	100	-	SHZ-412
Flight Director	-	100	-	FZ-702
IFC	-	-	-	- - -
Radar	100	-	-	- - -

INSTRUMENTS

Function	Co-Pilot Models	Pilot Models
HSI	Astronautics	11302-5
RMI		Sperry
CDI		0

Figure 6-11 IFR Rotorcraft Equipage for BELL 412

Manufacturer: Boeing Vertol
Type of Service: Commercial/Off-shore
Model: 234 Chinook

Number in Population: 3
Number IFR Certified: 3

AVIONICS

Function	% of Sample None	Single	Dual	Models
NAV	-	-	100	VIR-31H
DME	-	100	-	DME-40
ADF	-	100	-	ADF-60A
RNAV	-	100*	-	*VLF/Omega
Auto Pilot	-	100	-	Sperry
Flight Director	-	100	-	Sperry HELCIS II
IFC	-	-	-	
Radar	-	100	-	RDR-1400

INSTRUMENTS

Function	Co-Pilot Models	Pilot Models
HSI	Boeing Fligh Display	Boeing Fligh Display (234 ES 303)
RMI	Boeing Fligh Display	"
CDI	0	0

Figure 6-12 IFR Rotorcraft Equipage for BOEING VERTOL 234 CHINOOK

Manufacturer: Sikorsky
Type of Service: Corporate
Model: S-76

Number in Population: 51
Number IFR Certified: 51

AVIONICS

Function	% of Sample None	Single	Dual	Models
NAV	-	-	100	VIR-30A
DME	-	100	-	DME-40
ADF	-	100	-	ADF-60A
RNAV	-	100*	-	*Loran-C TI-91
Auto Pilot	-	*	-	- - -
Flight Director	-	-	*	ZC-301
IFC	-	-	100	SPZ-7000
Radar	-	100	-	RDR 1150XL

* Integrated Flight Control (IFC) Systems include autopilot and flight director capabilities.

INSTRUMENTS

Function	Co-Pilot Models	Pilot Models
HSI	Astronautics	Astronautics
RMI	RMI-36	RMI-36
CDI	Collins	Collins

Figure 6-13 IFR Rotorcraft Equipage for SIKORSKY S-76 CORPORATE

Manufacturer: Sikorsky
Type of Service: Off-Shore
Models: S-76

Number in Population: 86
Number IFR Certified: 86

AVIONICS

Function	% of Sample None	Single	Dual	Models
NAV	-	-	100	KNR-634
DME	-	100	-	KDM-706
ADF	-	100	-	KDF-806
RNAV	-	100*	0	Loran-C TDL-711A
Auto Pilot	-	90*	-	SAS-2
Flight Director	-	-	*	ZC-301
IFC	-	-	10	SPZ-7000
Radar	-	100	-	Primus 400SL, 40

* Integrated Flight Control (IFC) Systems include autopilot and flight director capabilities.

INSTRUMENTS

Function	Co-Pilot Models	Pilot Models
HSI	Astronautics	Astronautics
RMI	0 see HSI	0 see HSI
CDI	0	0

Figure 6-14 IFR Rotorcraft Equipage for SIKORSKY S-76 OFF-SHORE

CHAPTER SEVEN

CONCLUSIONS AND RECOMMENDATIONS

7.1 CONCLUSIONS

The majority of the IFR-equipped fixed-wing and rotorcraft aircraft registered in the United States are well equipped with dual navigation receivers, automatic direction finding equipment, distance measuring equipment, and associated displays and indicators. One hundred percent of the national carriers and 95 percent of the regional air carriers aircraft are equipped with radar systems. Executive jet aircraft are all instrumented with radar systems, while 80 percent of the turboprop population sampled had radar. Twin-engine piston aircraft in the cabin class frequently include radar capability in their avionic suites. RNAV capability is dictated by intended service of the aircraft and normally found on executive and cabin class propeller aircraft. The light twin and single engine IFR population shows almost 20 percent RNAV equipage.

The capabilities of the navigation equipment and displays vary according to the models installed in each airframe. We must research each model of avionics to identify the specific capability of each model, potential application in advanced approaches, and ability for integration of capabilities during the terminal phase of flight. The high percentage of radar systems currently installed in the airframes makes the radar display a prime candidate for providing additional information for advanced approaches.

Rotorcraft represent a large portion of the candidates for operation at large terminal areas, but the current equipage of the majority of the helicopters limits operation in IMC environment.

7.2 RECOMMENDATIONS

The results presented in this study provide the basis for evaluating the adaptation of existing avionics to advanced approach concepts using MLS guidance. However, each class of avionics (i.e., panel, remote

or ARINC) must be examined to identify whether adequate signal sources are available externally to adapt the avionics without changing them. Similarly, potential displays (e.g., radar systems, HSIs) must be examined by model to identify the feasibility of adding glide slope or course deviation information from the MLS angle receiver or computer without affecting the integrity of the instrument.

APPENDIX

LIST OF ACRONYMS

and

LIST OF AIRCRAFT MANUFACTURE CONTRACTIONS

LIST OF ACRONYMS

ADF	Automatic Direction Finder
ADI	Attitude Direction Indicator
APM	Program Engineering and Maintenance Service Division FAA
ARINC	Aeronautical Radio Corporation
ATC	Air Traffic Control
CDI	Course Deviation Indicator
CFR	Code of Federal Regulations
CRT	Cathode Ray Tube
DG	Directional Gyro
DME	Distance Measuring Equipment
EFIS	Electronic Flight Instrument System
FAA	Federal Aviation Administration
FBO	Fixed Base Operator
FD	Flight Directors
GA	General Aviation
GS	Glide Slope
HF	High Frequency
HSI	Horizontal Situation Indicator
IFCS	Integrated Flight Control System
IFR	Instrument Flight Rules
ILS	Instrument Landing System
IMC	Instrument Meteorological Conditions
LORAN	Long Range Navigation
MFR-Spec	Manufacture Specifications
MLS	Microwave Landing System
NS	Inertial Navigation System
NASA	National Aeronautics and Space Administration
NAV	VHF Navigation Radio: VOR/LOC
OMEGA	VLF Navigation System
PPI	Plan Position Indicator (Radar)
RAA	Regional Airlines Association
RJO	RJO Enterprises, Inc.
RMI	Radio Magnetic Indicator
RNAV	Area Navigation System
TP	Turbo Prop (Turbine engine with gear driven propeller)
VFR	Visual Flight Rules
VLF	Very Low Frequency
VOR	Very High Frequency Omni Directional Range
VSI	Vertical Speed Indicator

LIST OF AIRCRAFT MANUFACTURE CONTRACTIONS

A-	Airbus Industry
AA-	Grumman Corporation
AC-	Rockwell International (commanders, singles/piston twins and jet)
B-	Boeing Commercial Airplane Company
BA-	BAe/BAC British Aerospace Incorporated
BE-	Beech Aircraft Corporation
BH-	Beech Aircraft Corporation
BN-	Pilatus Britten-Norman Ltd.
C-	Cessna
CL-	Canadair Limited (Challenger)
CV-	Convair
DA-	Falcon Jet Corporation 10's and 20's
DC-	McDonnell Douglas
DHC-	DE Havilland Aircraft of Canada, Ltd.
EMB-	Embraer Aircraft Corporation
F	Fokker B.V.
FFJ	Falcon Jet Corporation/Avion Marcel Dassault-Breguet Aviation
G-	(I, II, III) Gulfstream Aerospace Corporation
G-	(21, 28, 44, 64, 73, 89, 134, 164) Grumman Corporation
GA	Rockwell International (Turbo Props)
HS-	British Aerospace Hatfield Chester Division
HS-	Hawker Siddeley
LA	Lake Aircraft
LR	Gates Lear Jet Corporation
M	Martin
MO	Mooney Aircraft Corporation
ML	Maule
MU	Mitsubishi
NA	Saberliner Corporation
PA	Piper Aircraft Corporation
SA	Fairchild Aircraft Corporation
SF	Saab—Fairchild
SH	(SD) Short Brothers Ltd.
WW	Israel Aircraft Industries


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The results presented in this study provide the basis for evaluating the adaptation of existing avionics to advanced approach concepts using MLS guidance. However, each class of avionics (i.e., panel, remote